Message from the editor-in-chief

Malaysian Online Journal of Educational Technology (MOJET) highlights the current issues in educational technology. MOJET is an international, professional referred journal in the interdisciplinary fields sponsored by Faculty of Education, University of Malaya. This journal serves as a platform for presenting and discussing the emerging issues on educational technology for readers who share common interests in understanding the developments of the integration of technology in education. The journal is committed to providing access to quality researches ranging from original research, theoretical articles and concept papers in educational technology.

In order to produce high quality journal, extensive effort has been put in selecting valuable researches that contribute to the journal. I would like to take this opportunity to express my appreciation to editorial board, reviewers and researchers for their valuable contributions to make this journal a reality.

Dr. Mübin KIYICI
July 2018
Editor in chief

Message from the editor

The Malaysian Online Journal of Educational Technology (MOJET) is aimed at using technology in online teaching and learning through diffusing information from a community of researchers and scholars. The journal is published electronically four times a year.

The journal welcomes the original and qualified researches on all aspects of educational technology. Topics may include, but not limited to: use of multimedia to improve online learning; collaborative learning in online learning environment, innovative online teaching and learning; instructional design theory and application; use of technology in instruction; instructional design theory, evaluation of instructional design, and future development of instructional technology.

As editor of the journal, it is a great pleasure to see the success of this journal publication. On behalf of the editorial team of The Malaysian Online Journal of Educational Technology (MOJET), we would like to thank to all the authors and editors for their contribution to the development of the journal.

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July 2018
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Investigation of the Effects of Social Self-Confidence, Social Loneliness and Family Emotional Loneliness Variables on Internet Addiction

Murat İskender [1]

http://dx.doi.org/10.17220/mojet.2018.03.001

ABSTRACT

This study aimed to investigate the relationship between internet addiction levels and social loneliness, family emotional loneliness and lack of social self-confidence levels of high school students. The study was conducted with 328 high school students. One hundred and sixty-five of the participants (50.3 %) were females and 163 (49.7 %) were males. The data were obtained with Internet Addiction Scale, Interpersonal Sensitivity Measure, and Social and Emotional Loneliness Scale. The study results showed that internet addiction and lack of social self-confidence, social loneliness and family emotional loneliness were related. As the result of stepwise regression analysis, it was found that the variable which best predicts internet addiction is the lack of social self-confidence ($R=0.649, R^2=0.422$), and that it was followed by social loneliness and family emotional loneliness respectively. The findings of the study were discussed in relation to the literature and some suggestions were presented.

Keywords: family emotional loneliness, high school students, internet addiction, social loneliness, social self-confidence

INTRODUCTION

The rapid developments in technology have made internet addiction an important behavioral, psychological and social health problem in recent years. The fact that social media, online games, chat, follow-up, banking, entertainment and other transactions can be done via the internet strengthens the addiction on internet. Internet, an important part of everyday life around the world, is a rapidly increasing tool for use not only among young people but also among adults and children. Besides being useful, it is known that overuse of the internet causes many health problems. Despite of being an indispensable part of everyday life for students, internet is seen as a serious problem that can result in academic failure, and negatively affects academic career and mental health (Geng, Han, Gao, Jou, Huang, 2018). Various studies have shown that excessive use of internet is particularly associated with physical and psychological problems (Greenfield, 2000; Hur, 2006), and that more importantly it leads to internet addiction (Young, 1998; Murali & George, 2007). Internet addiction is defined as a deficiency in controlling internet use which ultimately causes deterioration in psychological functions, interpersonal relations and academic performance (Young, 1998; Davis, 2001).

Internet addiction has many negative effects the individuals. For example, less life satisfaction (Ko, Yen, Chen, & Yen, 2005; Van den Eijnden, Meerkerk, Vermulst, Spijkerman, & Engels, 2008) (Moody, 2001; Nalwa & Anand, 2003; Ang, Chong, Chye, & Huan, 2012), family relations (Armstrong, Lagos, Baiocco, Lonigro,
Capacchione, & Baumgartner, 2012), and social isolation (Shaw & Black, 2008) are just some of them. There is a linear relationship between Internet addiction and depression, social isolation, loneliness, home-school and job performance decline (Caplan, 2002).

It can be said that the time spent on the internet has a negative effect on social relationships, and that it leads a person to both as social and emotional loneliness as long as he/she is online. It is thought that the problems in social and family relations may have an effect on a person’s addiction. Loneliness is the feeling of the individual’s lack of personal relationships with others (Fees, Martin, & Poon, 1999; Rook, 1989), and the lack of social networking in relationships. According to Weis (1973), loneliness includes both emotional loneliness and social isolation. Emotional loneliness is that an individual feels nothing for anybody or anything. Social loneliness is the lack of one in which the individual can share his feelings, dreams, ideals and insights. Loneliness is also a multidimensional phenomenon, varying in intensity, and across causes and circumstances (Salimia, 2011). The researches show that loneliness is related to social support (Wright, 2005), lower self-esteem (Levin and Stokas, 1986; Vanhalst, Goossens, Luyckx, Scholte, Engels, 2013), family problems (Wiseman, Mayseles and Sharabany, 2005), personality traits (Saklofske and Yackulic, 1989), social skills (Ponzetti and Cate, 1988), interpersonal trust (Rotenberg, 1994), self-criticism (Wiseman, 1997) poorer academic performance (Benner, 2011), and internet addiction (Huan, Ang, Chye, 2014; Özdemir, Kuzucu, Ak, 2014).

As shown in the research results, problematic family relations, self-esteem, social support, social skills, and inadequacy in interpersonal reliance can also be regarded as sources of low social self-efficacy as well as they are associated with loneliness. Lack of social self-efficacy is one of the factors that increase interpersonal sensitivity. Interpersonal sensitivity includes unreasonable and extreme awareness and sensitivity to the behavior and thoughts of others. In addition, the sense of personal inadequacy is often formed by misinterpreting the behavior of others, avoiding interpersonal relationships, and experiencing uneasiness in environments with others (Boyce, Hickie, Parker, Mitchell, Wilhelm, & Brodaty, 1992). When the low level of social self-confidence is combined with the feeling of personal inadequacy, the person's interpersonal sensitivity increases and the probability of choosing loneliness is getting stronger. Thus, the lack of social self-confidence will turn into a situation which leads an individual to avoid environments and interpersonal relationships with others, and to spend time in internet environment where he can express himself. Considering the positive relationship between loneliness, internet addiction (Huan, Ang, Chye, 2014; Moody, 2001; Ang, Chong, Chye, & Huan, 2012) and lower social self-efficacy (Iskender, Akın, 2010), it can be said that the lack of social self-confidence may strengthen this relationship.

When literature was examined, it was found that there was no study investigating the relationship between high school students' internet addiction levels and social loneliness, family emotional loneliness and lack of social self-confidence. In addition, revealing the relationship between the presented study and the mentioned variables will make it easier to present the proposals for prevention. Besides, revealing the relationships between the aforementioned variables in this study will facilitate to offer prevention suggestions. For these reasons, it was hypothesized that social loneliness, lack of social self-confidence, and loneliness in family relationships would be associated positively with internet addiction. In addition, it was also hypothesized that internet dependence is predicted by these three variables.

**METHOD**

In this study, it was aimed to examine the relationship between The Internet addiction levels of high school students and social loneliness levels, family emotional loneliness and lack of social self-confidence. Hence, the study which is a quantitative study is based on a relational research design. Relational research designs are used to determine the relationship and level of relationship between two or more variables and to predict possible outcomes from these relationships (Creswell, 2012; Fraenkel, Wallen, & Hyun, 2012).
Participants

The study group of the research consisted of 328 students who study in a high school. The Distribution of participants in the survey according to gender, age and income levels are presented in Table 1.

Table 1. Distribution of students in the study group by gender, age and income level

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>165</td>
<td>50.3</td>
</tr>
<tr>
<td>Male</td>
<td>163</td>
<td>49.7</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>25</td>
<td>7.6</td>
</tr>
<tr>
<td>15</td>
<td>167</td>
<td>50.9</td>
</tr>
<tr>
<td>16</td>
<td>125</td>
<td>38.1</td>
</tr>
<tr>
<td>17</td>
<td>11</td>
<td>3.4</td>
</tr>
<tr>
<td>Income level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inadequate</td>
<td>13</td>
<td>4.0</td>
</tr>
<tr>
<td>Moderate</td>
<td>231</td>
<td>70.4</td>
</tr>
<tr>
<td>Good</td>
<td>84</td>
<td>25.6</td>
</tr>
<tr>
<td>Total</td>
<td>328</td>
<td></td>
</tr>
</tbody>
</table>

When Table 1 is examined, it is seen that 165 (50.3%) of the participants are female and 163 (49.7%) are male. In addition, the age range of the participants range from 14 to 17 years and 25 (7.6%) are 14 years old, 167 (50.9%) are 15 years old, 125 (38.1%) are 16 years old, 11 years old. Participants' income levels were categorically asked and divided into categories as inadequate, and good. According to this, 4% of the respondents said that they are in the level of inadequate income, 70.4% are in the moderate level and 25.6% are in the good level.

Data Collection Tools

Internet Addiction Scale (Internet Addiction Scale)

The Internet Addiction Scale developed by Young (1996) was adapted to Turkish by Bayraktar (2001) and the Cronbach alpha internal consistency coefficient was found to be 0.91. It is a Likert type scale rated 0-5. The Internet Dependency Scale requires the marking of “Never”, “Rarely”, “sometimes”, “often”, “Very often” or “always”.

Interpersonal Sensitivity Measure

The scale was developed by Boyce and Parker (1989). The Turkish form of the scale was adapted by Dogan and Sapmaz (2012). As a result of the factor analysis, of the three factors which are different from the original five-factor scale, the first factor is called "inter-personal anxiety and addiction", the second is called "lack of social confidence", and the third is called "non-aggressive behaviours".

In this context, the Cronbach alpha internal consistency coefficient for the scale was found to be .81. In terms of sub-dimensions, the internal consistency coefficient was found to be .84 for "personal anxiety and addiction" subscale, .64 for "lack of social confidence" subscale, and .73 for "non-assertive behaviour" subscale. In this study, the lack of social self-confidence subscale was used for the interpersonal sensitivity scale.
Social and Emotional Loneliness Scale

The original scale consisting of fifteen items was developed by Ditommaso, Brannen, and Best (2004), and its adaptation to Turkish was held by Chechen (2007). Social and Emotional Loneliness Scale consists of three sub-dimensions: loneliness in family relations, romantic relationships, and social relations. The scale consists of 7 Likert scale grading (1: strongly disagree, 7: strongly agree). When the reliability coefficients of the scale are examined, loneliness sub-dimension is found to be .76 for the family relations, 84 for romantic relations, and .74 it for social relations (Çeçen, 2007).

Data Analysis

From the data obtained from the study, a simple correlation analysis was conducted in the analysis of the relationship between the internet addiction levels of students, social loneliness levels, family emotional loneliness, and lack of social self-confidence. Multilinear regression analysis was carried out to examine whether internet addiction could be predicted by social loneliness levels, family emotional loneliness, and lack of social self-confidence based on the relationship obtained. In regression analysis, in order to determine the best predictor of internet dependency stepwise regression analysis was carried out.

FINDINGS

The relationship between the internet addiction levels of 328 high school students participating in the study and their social loneliness levels, family emotional loneliness, and lack of social self-confidence was examined by simple correlation analysis. The descriptive statistics of correlated variables and the correlation values of the variables are presented in Table 2.

Table 2. Descriptive statistics and correlation values of internet addiction levels, social loneliness levels, family emotional loneliness, and lack of social self-confidence scores.

<table>
<thead>
<tr>
<th></th>
<th><strong>X</strong></th>
<th>SS</th>
<th>IA</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet Addiction (IA)</td>
<td>32,957</td>
<td>20,309</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predictive variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Lack of social self-confidence</td>
<td>20,304</td>
<td>5,606</td>
<td>0,649**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Social Loneliness</td>
<td>13,021</td>
<td>6,339</td>
<td>0,577**</td>
<td>0,410**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Family emotional loneliness</td>
<td>20,256</td>
<td>6,582</td>
<td>0,394**</td>
<td>0,334**</td>
<td>0,559**</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 shows that there is a statistically significant relationship between the Internet addiction and social loneliness, family emotional loneliness, and lack of social self-confidence. It has been found out that the internet addiction is positively and moderately related (r = 0.394, p <0.01) to lack of social confidence (r = 0.649, p <0.01), social loneliness (r = 0.577; p <0.01), and family emotional loneliness. When the relationship levels are examined, the highest relationship is seen between the internet addiction and lack of social self-confidence. It is followed by social loneliness and family emotional loneliness respectively.

Multiple linear regression analysis was used to examine whether the internet dependence was predicted by these variables which have a relationship as shown above. For the applicability of the regression analysis, the correlation between the independent variables and the dependent variable should be meaningful and the relation between the independent variables should not be higher than 0.80 (Büyüköztürk, 2006). The correlation values obtained in Table 2 show the suitability of these variables for multiple regression analysis. In addition, the Variance Increase Factor (VIF), Tolerance Value, and Condition index (CI) values are examined to check the multiple connection hypotheses from the basic assumptions of the multiple regression analysis. The results obtained are given in Table 3.
Table 1. Coefficient Table for Multiple Connection Assumption.

<table>
<thead>
<tr>
<th></th>
<th>Tolerance value</th>
<th>Variance Increase Factor (VIF)</th>
<th>Condition Index (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of social self-confidence</td>
<td>0.816</td>
<td>1.225</td>
<td>5,582</td>
</tr>
<tr>
<td>Social loneliness</td>
<td>0.631</td>
<td>1.584</td>
<td>8,885</td>
</tr>
<tr>
<td>Family emotional loneliness</td>
<td>0.674</td>
<td>1.484</td>
<td>10,831</td>
</tr>
</tbody>
</table>

It is expected that the Tolerance value examined for the multiple link assumption is higher than 0.10, the Variance Increase Factor (VIF) value is less than 10, and the Condition Index (CI= Condition Index) is less than 30 (Hair, Black, Babin, Anderson & Tatham, 2006; Tabachnick, Fidell, & Osterlind, 2001; Uyanık and Güler, 2013). When examined in terms of all these boundaries, it is seen that there is no multiple connection problems in the data set used in the study and the data are suitable for multiple linear regression analysis.

Internet addiction of high school students; lack of social self-confidence, social loneliness levels and family emotional loneliness were used to examine the effect of predictive variables on internet addiction using multiple regression analysis using stepwise regression technique. By taking account of the relationship between the independent variables and the internet addiction in the stepwise regression, the predictive variables were included in the model and the results are given in Table 4.

Table 2. The level of predicting internet addiction of the lack of social self-confidence, social loneliness and family emotional loneliness variables.

<table>
<thead>
<tr>
<th>Model</th>
<th>Predictive Variables</th>
<th>B</th>
<th>Standard Error</th>
<th>β</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stable</td>
<td>5,866</td>
<td>1,954</td>
<td>0,649</td>
<td>3,003**</td>
</tr>
<tr>
<td></td>
<td>Lack of social self-confidence</td>
<td>2,080</td>
<td>0,135</td>
<td></td>
<td>15,416**</td>
</tr>
<tr>
<td></td>
<td>R=0,649</td>
<td>R²=0,422</td>
<td>F=237,664</td>
<td>p=.000</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Stable</td>
<td>-11,123</td>
<td>2,565</td>
<td>0,496</td>
<td>-4,336**</td>
</tr>
<tr>
<td></td>
<td>Lack of social self-confidence</td>
<td>1,589</td>
<td>0,132</td>
<td></td>
<td>12,004**</td>
</tr>
<tr>
<td></td>
<td>Social Loneliness</td>
<td>1,154</td>
<td>0,128</td>
<td>0,374</td>
<td>9,053**</td>
</tr>
<tr>
<td></td>
<td>R= 0,734</td>
<td>R²= 0,538</td>
<td>F=189,325</td>
<td>p=.000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Stable</td>
<td>-12,160</td>
<td>3,069</td>
<td>0,493</td>
<td>-3,962**</td>
</tr>
<tr>
<td></td>
<td>Lack of social self-confidence</td>
<td>1,578</td>
<td>0,134</td>
<td></td>
<td>11,792**</td>
</tr>
<tr>
<td></td>
<td>Social Loneliness</td>
<td>1,110</td>
<td>0,147</td>
<td>0,360</td>
<td>7,573**</td>
</tr>
<tr>
<td></td>
<td>Family emotional loneliness</td>
<td>0,103</td>
<td>0,167</td>
<td>0,028</td>
<td>1,617*</td>
</tr>
<tr>
<td></td>
<td>R= 0,751</td>
<td>R²= 0,564</td>
<td>F=126,103</td>
<td>p=.000</td>
<td></td>
</tr>
</tbody>
</table>

The Dependent Variable: Internet addiction, *p<0.05; **p<0.01

When the findings in Table 4 are examined, it is seen that the regression model created to determine the total internet dependency power of the independent variables is statistically significant [F = 126,103, p <0.01]. According to the results of stepwise regression analysis, 3 steps were included in the multiple regression analysis.

In the first step of the stepwise regression, the predicted lack of social confidence analysis may explain 42% of the total variance related to internet dependence (R = 0.649, R² = 0.422). In this step, Beta coefficient
of lack of social self-confidence was 0.649 and t value was statistically significant (t = 15.416, p < 0.01).

In the second step of the stepwise regression analysis, the social loneliness variable has been included in the model along with the lack of social self-confidence. Lack of social self-confidence and social loneliness variables together can explain 54% of the Internet addiction (R = 0.734, R² = 0.538). In this case, it can be said that the social loneliness variable contributes 12% to the equivalence. In the second model, Beta coefficient of lack social variable is 0.496; Beta coefficient for the variable of social loneliness was calculated as 0.374. The t values for both variables were statistically significant (t = 12.004, t = 9.053, p < 0.01, respectively).

In the third step of the stepwise regression analysis, family emotional loneliness variables were included in the model as well as the lack of social self-confidence and social loneliness variables. Three of the variables of social self-confidence, social loneliness and family emotional loneliness together can explain 56% of total variance related to the Internet dependence (R = 0.75, R² = 0.564). Accordingly, it can be said that the variable of the family emotional loneliness contributed 2% to the regression equation. In this step, the Beta coefficient for the variable of lack of social self-confidence was calculated as 0.493, Beta coefficient for the social loneliness variable was 0.360 and Beta coefficient for the family emotional loneliness variable was calculated as 0.028. The t values of all three variables were found to be statistically significant (t = 11.792, t = 7.573, p < 0.01; t = 1.617, p < 0.05, respectively).

When the values of Beta and R² were examined in terms of social self-confidence, social loneliness and family emotional loneliness variables, it was found that the internet addiction of the high school students was statistically significant in that lack of social self-confidence comes first, social loneliness comes second and family emotional loneliness comes in the third place. According to the results of the multiple regression analysis, the regression equation for predicting students' Internet dependence is as follows:

\[
\text{Internet addiction} = -12,160 + 1,578 * (\text{lack of social self-confidence}) + 1,110 * (\text{social loneliness}) + 0.103 * (\text{family emotional loneliness})
\]

**DISCUSSION**

In this study, it was aimed to investigate the relationship between the high school students' Internet addiction levels and social loneliness, family emotional loneliness and lack of social self-confidence. As the result of the study, internet addiction and lack of social self-confidence, social loneliness and family emotional loneliness were found to be related. The stepwise regression analysis showed that the variable which best predicts internet addiction was the lack of social self-confidence, and that it was followed by social loneliness and family emotional loneliness respectively.

Firstly, results of this study demonstrated that lower social self-confidence, social loneliness, and family emotional loneliness were related positively to Internet addiction. This result overlaps with the literature. It can be said that young people who have low self-esteem and inadequacy feel shy in friendship relations and have less relationship with their friends (Wadell, 1984), and therefore low self-confidence leads to loneliness. Considering the fact that social self-confidence is influenced by social skills, it can be said that individuals with low social skills receive less social support than those with high social skills (Argyle, 1992), especially the support that can not be obtained from family and friends directs an individual to loneliness and Internet. At this point, The individual may now be someone who avoids interpersonal relationships and is experiencing discomfort in environments with others (Boyce et al., 1992). There is a linear relationship between internet addiction and loneliness (Nalwa & Anand, 2003; Ang et al., 2012), family relations (Lo Cascio et al., 2013; Laghi et al., 2012), social isolation (Caplan, 2002; Shaw & Black, 2008), and decrease in home-school performance (Caplan, 2002).
Secondly, it was found that the variables which predict internet addiction were lack of social self-confidence, social loneliness and family emotional loneliness respectively. In addition to the lack of social self-confidence, that social loneliness and family emotional loneliness predict Internet addiction supports literature. The researches shows that loneliness is related to social support (Wright, 2005), family problems (Wiseman et al. 2005), social skills (Ponzetti and Cate, 1988), interpersonal trust (Rotenberg, 1994), poorer academic performance (Benner, 2011), personality traits (Saklofske and Yackulic, 1989), and internet addiction (Moody, 2001; Nalwa & Anand, 2003; Ang et al., 2012; Huan, Ang, Chye, 2014; Özdemir, Kuzucu, Ak, 2014).

In conclusion, it can be considered that some contributions can be made to the literature with this study. Primarily, this study is important because it examines internet addiction, lack of social self-confidence, social loneliness and family emotional loneliness together. That the study group consisted of the high school students may be the limitation of this study. The researchers can achieve this limitation by working with more extensive groups. In addition, only variables of social self-efficacy, social loneliness and family emotional loneliness were used to predict internet addiction. This study can be done with different variables by taking advantage of the field.

REFERENCES


Examining Pre-Service Mathematics Teachers’ Beliefs of TPACK during a Method Course and Field Experience

Büşra KARTAL[1], Cengiz ÇINAR [2]

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ABSTRACT

The aim of this study is to investigate how and why elementary mathematics pre-service teachers’ (PSTs) beliefs about TPACK changed during a method course and field experience. Six PSTs were selected purposefully with reference to their different technological and mathematical backgrounds. Participants were interviewed five times (beginning of the study, after workshops, after method course, beginning and end of field experience) and interviews were conducted within the context of Niess (2005)’ TPACK components. Content analysis was performed with the help of a codebook developed by reviewing TPACK components literature. It has been seen that PSTs had naïve beliefs at the beginning of the study. Workshops, method course and field experience seemed to change their beliefs. Management concerns began to affect beliefs when PSTs’ experiences about teaching with technology increased. It was suggested to give more opportunities for PSTs to teach with technology because; it was found that experiences had the most effect on beliefs.

Keywords: technological pedagogical content knowledge (TPACK), pre-service teachers, mathematics education, beliefs

INTRODUCTION

Rapidly changing and developing technological tools have affected the styles of learning and teaching mathematics (Heid, 2005; Isıksal & Askar, 2005; Kaput, 1992). In technology-rich classrooms, students can develop multiple representations (Heid, 2005), focus on conceptualizing, decision-making, reflecting, reasoning, and problem solving (Lee & Hollebrands, 2008; NCTM, 2000; Tall, 1998), and engage with activities with high motivation and explore mathematical ideas (Geiger, Forgasz, Tan, Calder, & Hill, 2012). But most of the teachers don’t use technology to support student’s learning as mentioned; instead they use technology for planning lesson, data storage, presentation, and finding online resources (Chen, 2010; Inan & Lowther, 2010). The main reason why they use technology in this manner is assumed as teachers didn’t learn mathematics with technology (Niess, 2006). Even if they had experiences with teaching and learning mathematics with technology, especially experienced teachers may wonder about losing control in classrooms and may not need a change in their teaching professions (Pierce, Ball, & Stacey, 2009). Based on the development of technology, mathematics educators were supposed to study how technological tools can be used to support mathematical thinking (Niess, 2006). Researchers (Angeli & Valanides, 2005; Keating & Evens, 2001; Koehler & Mishra, 2005; Margerum-Leys & Marx, 2002; Niess, 2005) attempted to determine what teachers should know in order to use technology effectively. It was seen that the common idea was technology-supported pedagogical knowledge. The most known framework is the notion of TPACK developed by Koehler and Mishra (2005), which is used to define teacher knowledge needed for effective technology integration.
Many researches show that in/pre-service teachers’ beliefs and experiences with technology play an important role on their decisions about use of technology (Cavin, 2007; Ertmer, Ottenbreit-Leftwich, & York, 2006; Larkin, Jamieson-Proctor, & Finger, 2012; Mudzimiri, 2012). Pre-service teachers’ (PSTs’) knowledge, beliefs, and attitudes will give information about how they will use technology in their future class (Abbitt, 2011). So determining what they know and think about teaching mathematics with technology can help teacher educators and administrators to design professional development programs that will prepare teachers so as to teach digital natives (Prensky, 2001) and will lead to belief change. It can be said that teacher beliefs may be more effective in teaching than teacher knowledge (Pajares, 1992). PSTs’ beliefs and conceptions about teaching with technology affect to what extent they perceive and use instructional strategies in their teacher preparation programs (Tillema & Knoll, 1997). They bring personal beliefs about teaching style of a good teacher and thinking themselves as a teacher, and pupilage memories to teacher education programs. These existing beliefs need to be evolved and reconstructed to enable professional growth (Kagan, 1992).

Distinguishing beliefs and knowledge is difficult (Pajares, 1992). PSTs’ beliefs about the nature of teaching with technology may contribute to teacher education programs to promote teacher knowledge and support conceptual change. Specifying the knowledge base that is to be considered is crucial in assessing PSTs’ beliefs (Fives & Buehl, 2009). TPACK can be used as a knowledge base to understand what kind of beliefs about teaching mathematics with technology PSTs have. TPACK can be used to investigate PSTs’ knowledge, beliefs, and reasoning during technology integration (Jones, 2012). Unpacking PSTs’ beliefs of TPACK may be a guide to determine how they will organize and define technology-based mathematical tasks and problems (Pajares, 1992).

PSTs’ reasoning and intentions about teaching with technology may be more obvious in their views than behaviors (Jones, 2012). PSTs with different mathematical and technological background were participated in this study. They were interviewed five times; at the beginning, after workshops, after method course, before and after field experience to examine how and why their beliefs about technology change. It is thought that determining the pattern and reason of belief change in PSTs’ TPACK may contribute to enhance teacher knowledge needed for effective technology integration.

Technological Pedagogical Content Knowledge in Mathematics Education

Shulman’s (1986) notion of Pedagogical Content Knowledge (PCK) includes using appropriate technologies in presenting concepts when teachers need (Cox & Graham, 2009). Ertmer and Ottenbreit-Leftwich (2010) argued that PCK definition let teachers to think they are good at teaching, even if neither they nor their students use technology. Koehler and Mishra (2008) suggested that knowledge of technology should be incorporated into PCK due to role of technology in society and rapid changes of technology. TPACK is the way of thinking about teacher knowledge to teach mathematics with appropriate technologies in constructive and effective ways.
TPACK was developed by adding knowledge of technology to Shulman’s idea of PCK. TPACK framework consists of seven knowledge bases; main components are knowledge of technology (TK), pedagogy (PK) and content (CK) and the intersections between these domains are Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), and intersection of these: Technological Pedagogical Content Knowledge (Figure 1). Technological pedagogical mathematical knowledge, knowledge need for teaching mathematics with technology, includes knowledge of mathematics content that students are expected to learn, knowledge of pedagogies related to mathematics content and knowledge of technology that provides using technology to support teaching and learning mathematics (Polly, 2014).

Niess (2013) discussed two perspectives about TPACK: integrated and interdisciplinary. Interdisciplinary perspective refers that all of the sub-domains (TK, PK, CK, TPK, TCK, PCK and TPACK) are considered independently. On the other hand integrated view emphasizes the transformation of all sub-domains into center intersection: TPACK. Niess (2013) identified this transformation as a chemical change in which the other knowledge bases are rearranged and integrated. However, Archambault and Barnett (2010) argued that distinguishing each of these domains is difficult. Niess (2013) identified four components of TPACK that is the center subset, extending Grossman’s (1990) PCK components;

(i) An overarching conception about the purposes for incorporating technology in teaching mathematics (purpose)

(ii) Knowledge of students’ understandings, thinking, and learning in mathematics with technology (student)

(iii) Knowledge of curriculum and curricular materials that integrate technology in learning and teaching mathematics

(iv) Knowledge of instructional strategies and representations for teaching and learning mathematics with technology

PSTs’ beliefs and knowledge about TPACK components rely on their little experiences with accessing technology and they are also naïve and deficient (Niess, 2008). Teaching PSTs mathematics with technology is a way to improve PSTs’ overarching conception of what it means to teach with technology (Niess, 2005). They should be given the opportunity to use appropriate technologies with students, employing curricular
materials and instructional strategies that integrate technology into teaching and learning mathematics to
develop their knowledge about instructional strategies and curricular materials. They also need these
opportunities to interact with students and explore their thinking about mathematics in technology-rich
classrooms.

Technology provides opportunities for students to visualize mathematics, engage with mathematics,
verify conjectures and have positive attitudes about mathematics (Kersaint, 2007). Teachers of mathematics
should possess TPACK to give their students these opportunities. TPACK requires planning, organizing,
critiquing and abstracting mathematics with technology for specific students in a specific classroom situation
(Niess, 2008). Most of the PSTs are not proficient in planning and implementing lessons with appropriate
technologies in classrooms because they didn’t learn mathematics in technology supported classrooms.
Teachers of mathematics with strong TPACK (i) are open to new technologies and know that students can
explore mathematical ideas with appropriate technologies; (ii) look for the ways of teaching mathematical
concepts with technology; (iii) know what students know and learn, and how technology supports students;
(iv) explain students why technology is used and what they will do with technology; and (v) adopt teaching
with technology due to students’ learning (Grandgenett, 2008).

Most of the studies examined PSTs’ TPACK within the context of the courses (Larkin et al., 2012;
Meagher Ozgun-Koca, & Edwards, 2011; Mudzimiri, 2012; Niess, 2005; Ozgun-Koca, Meagher, & Edwards,
2010), the professional development programs (Agyei & Voogt, 2012; Cavin, 2007), or the projects
(Harrington, 2008; Lee & Hollebrands, 2008) that include planning and teaching technology-based
mathematics lessons. Results show that PSTs made the most progress when they were demonstrated models
of teaching with technology. Technology-enhanced method courses and field experience have an effect on
especially PSTs’ purpose, student and strategy components (Meagher et al., 2011).

Beliefs about Teaching with Technology and Belief Change

Teacher beliefs arise from their experiences related to themselves, instruction and mathematical
knowledge (Richardson, 1996). PSTs have limited, formal, and robust beliefs about mathematics that are
resistant to change (Larkin et al., 2012) and think that mathematics must be taught in the same way as they
learnt. Their views may change slowly at best (Thompson, 1992). There is a relationship between PSTs’ beliefs
about technology use and beliefs about how mathematics should be taught. Teachers who have rule-based
beliefs about mathematics cannot consider technology as a tool to improve or enhance instruction and would
like to control students’ use of technology (Tyminski, Haltiwanger, Zambak, Horton, & Hedetniemi, 2013).
Teachers’ resistant to change beliefs about technology is one of the reason that affect technology integration
(Zelkowski, Gleason, Cox & Bismarck, 2013).

Meagher et al. (2011) grouped PSTs into three categories according to their beliefs about teaching with
technology; naysayers, yes-but, and yes-and. In the first category, PSTs don’t tend to use technology. Yes-
buts emphasize firstly teaching concepts and then using technology while yes-ands consider technology as a
learning tool. Most of PSTs learnt mathematics in traditional environments so they are mostly in the first and
second category (Meagher et. al, 2011). In another study related to teachers’ beliefs about teaching with
technology, Hanzsek-Brill (1997) determined three positions of beliefs according to teachers’ views about
when technology should be used. These beliefs were labeled as exploratory, post-mastery, and pre-mastery.
Teachers with exploratory beliefs think that students can explore mathematical concepts and procedures
with technology. Post-mastery beliefs refer to using technology after mathematical concepts and procedures
have been mastered by hand. Teachers with pre-mastery beliefs use technology rarely and minimally
productively before their students have mastered mathematical concepts and procedures (Leatham, 2007).The last classification of beliefs about teaching with technology was made by Zbiek and Hollebrands
(2008) based on teachers’ concerns. They identified beliefs in three groups; personal concerns, management
concerns, and technology concerns. Personal concerns consist of teachers’ views about themselves. Management concerns are related to classroom management and student learning. Lastly, technology
cconcerns are about using technology effectively (Tyminski et al., 2013).
Abbitt (2011) suggested promoting PSTs’ TPACK may lead to belief change in teaching efficiently with technology. Enabling PSTs to think about using technology differently and effectively is another way of actualizing belief change (Brown, 2015). But factors such as role of the subject and school culture are needed to be considered when investigating PSTs’ change in technology practices (Ertmer & Ottenbreit-Leftwich, 2010).

Researches in which PSTs were asked to plan and implement technology-based lessons found that PSTs’ views and beliefs shift from using technology to do math faster or practice drill towards enabling relational understanding and conceptual knowledge with technology (Cavin, 2007; Mudzimiri, 2012; Ozgun-Koca et al., 2010). Harrington (2008) found out that PSTs’ beliefs changed through a mathematics licensure program in which TPACK development was encouraged with field experience, TPACK-centered assignments and discussions. PSTs’ beliefs moved from doing technology to using technology and from considering technology as an extension/simplifier to an enhancer/differentiation in the purpose component. In the student component, PSTs’ views were identified as visualizing and abstraction with technology, and motivation.

**Purpose and Research Questions**

It may be implied that PSTs’ beliefs play an important role in predicting their future decisions and classroom practice related to technology. Determining what they think about teaching with technology within the context of technology’s role, students, curriculum, and instructional strategies may help teacher educators to revise teacher preparation programs. This study took three semesters. PSTs’ beliefs were traced during a long time. Merriam (2009) stated that collecting data for a long time gives researchers the opportunity to analyze data continually and to clarify concepts. This allowed the researchers to see the factors that shaped PSTs’ beliefs and to find the patterns in their belief change while PSTs were enhancing their skills and knowledge about mathematics, pedagogy, and technology. This study aims to investigate PSTs’ beliefs and changes in their beliefs about TPACK. For this purpose, TPACK components developed by Niess (2005) were used. Researchers attempted to answer the questions below:

1. What were PSTs’ overarching conceptions about the purposes for incorporating technology in teaching mathematics and how did they change during study?
2. What were PSTs’ beliefs about students’ understandings, thinking, and learning in mathematics with technology and how did they change during study?
3. What were PSTs’ beliefs about curriculum and curricular materials that integrate technology in learning and teaching mathematics and how did they change during study?
4. What were PSTs’ beliefs about instructional strategies and representations for teaching and learning mathematics with technology and how did they change during study?
5. What were the factors that affected PSTs’ beliefs about TPACK components?

**METHOD**

This study is an embedded-multiple case study aimed to (a) answer “how” and “why” PSTs’ beliefs of TPACK change, and (b) determine the contextual conditions that have an impact on PST’ beliefs of TPACK (Yin, 2003). Six PSTs were taken as different cases and TPACK components developed by Niess (2005) were determined as the unit of analyses. PSTs were selected due to their different mathematical and technological background. With this various selection, researchers attempted to gain a common pattern of PSTs’ beliefs with the help of semi-structured interviews.

**Context**

There have been several developments related to teacher education and curriculum since early
2000s in Turkey. Technology was first seen in National Mathematics Curriculum in 2005 and using technology effectively was considered as an essential skill that students are expected to have in 2009. In consistent with these developments, Turkey Ministry of Education developed a project called Movement of Enhancing Opportunities and Improving Technology (FATIH) in 2010 and began to put the project into action in 2012. Within the context of FATIH project, classrooms and schools were equipped with available technological tools such as interactive boards, tablets, internet access and specific portals (Ministry of National Education, 2016). This project has been the greatest training investment about educational technology use to date in Turkey. This may imply that technological opportunities are developing recently and preparing teachers to teach with technology is becoming a crucial issue in order to achieve the objectives of FATIH Project in Turkey.

The first two years are mostly content-based in Teacher Preparation Program (TPP) in which study was conducted. PSTs begin to enroll subject-specific method courses from third year of program. Field experience is two-semester long, in the last year. First semester of field experience includes PSTs’ observations about school distinct, administrators, co-operating teachers, students, and technical and physical features e.g.; second semester includes teaching practicum of PSTs. In the TPP in which this study is carried out, PSTs learn GeoGebra and Mathematica. PowerPoint representations were the most common used technological tool. Mathematics class had interactive whiteboards and mathematics software, and virtual manipulatives. In Turkey students enter high-schools and universities with central entrance exams in which there are multiple-choice questions that must be answered at a given time. These exams make students and teachers pay more attention to results instead of solution process. Therefore, most of them didn’t learn mathematics or any subject matter with technology to get a rich repertoire of solutions to problems in a short span of time.

Participants

Participants of this study were 6 PSTs who were juniors at a mathematics teacher preparation program in the midst of Turkey at a rural setting. Participants were determined purposefully via maximum variation sampling to represent different cases in terms of technology and mathematics and to get a comprehensive understanding of perspectives of the different cases (Creswell, 2012). This variation in participants may lead to present different findings. A TPACK self-assessment survey and a polygon questionnaire were administered to 33 PSTs. TPACK survey was developed by Kartal, Kartal, and Uluay (2016). The survey was 7 point Likert style and consists of 67 items which aim to identify pre-service teachers’ self-assessments about teaching with technology. However, polygon questionnaire (Kartal & Çınar, 2017) included 19 open-ended items related to PSTs’ mathematical knowledge of polygons. 6 PSTs were chosen based on their scores from TPACK survey and polygon questionnaire. Their scores were classified into three levels due to a formula used by Fettahlioglu, Ozturk, Dag, Kartal, and Ekici (2012). Table 1 shows the PSTs’ level of TPACK and mathematical knowledge of polygons in the study group.

<table>
<thead>
<tr>
<th>Participant</th>
<th>TPACK</th>
<th>Polygons</th>
</tr>
</thead>
<tbody>
<tr>
<td>PST-1</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>PST-2</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>PST-3</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>PST-4</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>PST-5</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>PST-6</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

Data Collection Tool

PSTs’ beliefs about TPACK were examined through face-to-face interviews which are one of the main data collection sources to examine “how” and “why” questions in case study (Yin, 2003). A draft of interview protocol was developed based on the four TPACK components reviewing literature (Cavin, 2007; Harrington, 2008; Mudzimiri, 2012; Niess, 2013). Draft has been sent to two experts who have studied TPACK. After expert review, pilot of the draft has been performed with two PSTs. The PSTs weren’t participant and they were asked to read, think about and answer questions aloud (Bowles, 2010). The aim of think aloud strategy
was to be sure that items were understood by PSTs in the same way. Final form of the interview protocol has questions related to PSTs’ views about TPACK components (Appendix). Interviews were conducted five times (Figure 2) and took approximately 20 minutes. The same interview protocol was used for each interview to identify different patterns of belief change. All of the interviews were recorded with the permission of participants.

Data Collection Process

This study occurred in the PSTs’ natural setting during a method course and field experience. PSTs were interviewed five times. At the beginning of the study PSTs were interviewed for the first time. It has been seen that PSTs believed that technology should be used for the purpose of brief and visual representation of mathematical concepts at the end of the interview. Workshops were designed to attempt changing their beliefs from using technology as a representation tool to using as a learning tool and focused on TPACK, how to integrate technology, pedagogy and mathematics. Five workshop sessions took totally ten hours. The sessions aimed to demonstrate using different technological tools (e.g. calculators, applications, websites, dynamic geometry software, and computer algebra systems) in such a way that enable students to explore mathematical ideas with these tools. Models of teaching different topics such as numbers, geometry and algebra were shown. First researcher acted as a teacher and PSTs as students. PSTs have known GeoGebra and they reported that they didn’t think to learn and use new software in their teaching practices because of language. GeoGebra serves in Turkish and this feature makes GeoGebra practical and attractive in Turkey. They weren’t introduced new software instead they were encouraged to use technology in a constructive and fruitful way.

After workshops PSTs were interviewed for the second time. Method course was designed to promote PSTs to understand approaches, strategies, and issues that are relevant to the teaching and learning of mathematics. They were introduced how to teach numbers, fractions, geometry, algebra, and measurement. Technology was integrated with some applications, smartboard and Web sources into the course but, TPACK was not mentioned especially. Then, they planned and implemented a short technology-based microteaching in the context of method course. They evaluated their microteaching practices and implemented the same profession second time to a different group. Third interview were performed with them at the end of method course. Data collection process is given in Figure 2.

![Figure 2. Time schedule showing when interviews were performed](www.mojet.net)
evaluation meeting, the first researcher came together with groups individually and guided them to plan the second implementation. The topic they chose to teach wasn’t different in the implementations. They re-planned their lessons based on their and peers’ evaluations and taught the same topic to a different group. The aim of the implementations was determined as effective technology integration and mathematical explorations made by students. Following re-planning, PSTs implemented their re-planned lessons second time in real classrooms. They were interviewed for the last time after field experience, just before their graduation.

Data Analysis

Content analysis was used in this study. TPACK components of Niess (2005) were determined as the themes of qualitative data. Interviews were transcribed in their entirety and coded based on the four components using a codebook (Table 2) which was developed by researchers reviewing the literature related to TPACK components (Harrington, 2008; Meagher et al., 2011; Mudzimiri, 2012; Niess, 2013). After coding, similar codes were gathered so as to constitute categories. For example, the codes of drawing students’ attention to mathematics and making students enjoy mathematics created the category of developing positive attitudes. Once data for a participant were analyzed, the process was repeated with the data for other participants respectively. After analyzing all the data, similarities and differences in codes were examined to form a pattern in the change of TPACK components. Researchers analyzed the data independently due to codebook and then came together to explain their codes and interpretations. They discussed on the similarities and differences between their coding schemes and argued until 100% consistency was reached (Miles & Huberman, 1994).

Table 2. Codebook used for data analysis

<table>
<thead>
<tr>
<th>Knowledge component</th>
<th>Descriptive component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conception about purposes for incorporating technology</td>
<td>Role of the technology&lt;br&gt;How technology supports student to learn important ideas&lt;br&gt;How to use technology</td>
</tr>
<tr>
<td>Knowledge of students’ thinking and learning with technology</td>
<td>PSTs’ views about how students learn mathematics with technology&lt;br&gt;PSTs’ views in which they place themselves in the position of the students</td>
</tr>
<tr>
<td>Knowledge of curriculum and curricular materials</td>
<td>PSTs’ views about appropriate technological tools that can be used in mathematics education&lt;br&gt;Knowledge of instructional strategies and representations to teach a particular mathematical content&lt;br&gt;PSTs’ views about technology use&lt;br&gt;PSTs’ views about whether using technology to support known concepts or to develop new concepts</td>
</tr>
<tr>
<td>Knowledge of instructional strategies and representations</td>
<td></td>
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</tbody>
</table>

Reliability

Reliability is the credibility of qualitative studies. Initially, prolonged engagement in the field was conducted (Creswell, 2012). First researcher attended the teaching method course during two semesters to make PSTs feel comfortable with her. This was an important component of building trust with PSTs. Triangulation of data source was carried out by gathering data from participants who have different technological background and mathematical knowledge (Plano Clark & Creswell, 2015). Peer review was the last step for trustworthiness. Researchers planned and organized study together. Especially, researchers examined the data independently in data analysis.
FINDINGS

Data from each of the TPACK components was analyzed independently to see the change during method course and field experience for each participant and discover patterns from participants. Original quotes from PSTs were given to provide comprehensive understanding about components.

**PSTs’ Belief Change in Overarching Conception about the Purposes for Incorporating Technology in Teaching Mathematics**

The first component about purpose for integrating technology in teaching mathematics refers to teachers’ beliefs of what is important in that subject and how technology supports students to learn that important point, and what teaching with technology means for PSTs (Niess, 2013). These views are often untried by PSTs (Meagher et al., 2011). PSTs’ views about overarching conception were analyzed into two subcategories; the role of technology and how technology support students. PSTs’ beliefs about their overarching conceptions of teaching mathematics with technology were given in Table 3.

**Table 3. PSTs’ beliefs about their overarching conceptions of teaching mathematics with technology**

<table>
<thead>
<tr>
<th>Time</th>
<th>Technological self-assessment level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Role of technology</td>
</tr>
<tr>
<td>At the beginning of study</td>
<td>High: Visual representation</td>
</tr>
<tr>
<td></td>
<td>Medium: Visual representation</td>
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<tr>
<td></td>
<td>Low: Visual representation</td>
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<td></td>
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<tr>
<td>After workshops</td>
<td>Role of technology</td>
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<tr>
<td></td>
<td>Simplifier</td>
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<tr>
<td></td>
<td>Giving more examples</td>
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<td></td>
<td>Calculations</td>
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<tr>
<td></td>
<td>Motivation</td>
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<td></td>
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<tr>
<td>After method course</td>
<td>Role of technology</td>
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<tr>
<td></td>
<td>Simplifier</td>
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<tr>
<td></td>
<td>Giving more examples</td>
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<td></td>
<td>Calculations</td>
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<tr>
<td></td>
<td>Motivation</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Beginning of the field experience</td>
<td>Role of technology</td>
</tr>
<tr>
<td></td>
<td>Simplifier</td>
</tr>
<tr>
<td></td>
<td>Giving more examples</td>
</tr>
<tr>
<td></td>
<td>Calculations</td>
</tr>
<tr>
<td></td>
<td>Motivation</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>After field experience</td>
<td>How technology supports students</td>
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<td>------------------------</td>
<td>---------------------------------</td>
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<tr>
<td></td>
<td>Meaningful learning</td>
</tr>
<tr>
<td></td>
<td>Promoting estimation and generalization</td>
</tr>
<tr>
<td></td>
<td>Meaningful learning</td>
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It can be seen that PSTs perceived the role of technology as a visualization tool. Only one PST with a high level of mathematics and technological self-assessment remarked that visualization provides students proof without words. None of them didn’t state an opinion about how visualization supports student learning. One PST argued that technology cannot be used for all mathematics topics and insisted on visualization especially in order to concrete:

“Technology doesn’t work for all topics in mathematics, but it (technology) is really useful for some topics which can be visualized. It has an importance in concretization.” (PST-3)

After workshops, only PSTs that have a medium-level self-assessment about teaching mathematics with technology reported their beliefs about the role of technology. PSTs’ beliefs about the ability of technology to make things easier constituted the idea of Simplifier. In the second interview, PSTs remarked that it is easier to give more examples with technology. PSTs pointed out that the accessibility of technology by all of the students is an important factor in supporting students’ learning. At the end of the method course, they insisted on visualization. But they added purposes for integrating technology such as motivation and simplifying. PSTs’ beliefs about role of the technology such as making the lesson more enjoyable and drawing students’ attention created the emerging theme “Motivation”. PSTs argued that using technology for these purposes help students learn mathematics meaningfully and have a relational understanding. A PST explained how dynamic geometry software (DGS) simplifies drawing more and accurate diagrams and how this helps saving time and avoids rote learning. Another PST reported that she realized to teach mathematics enjoyably:

“For example, if I attempt to draw a rectangular and parallelogram on the blackboard, I have to show different types of geometric shapes. But dragging gives the opportunity to gain a new view of that geometric shape in DGS. It avoids losing time. Students see accurate shapes and I think this helps them to understand what really that shape is and to avoid memorizing.” (PST-3)

“In fact, mathematics can be taught in an enjoyable way with technology. Math is mostly known as boring, but we can do math lessons more enjoyable and direct students’ attention to lesson more.” (PST-4)

At the beginning of the field experience, all of the PSTs emphasized the same roles of technology; Visual Representations, Simplifier, and Motivation. But new beliefs about how technology promotes student learning emerged. PSTs that have a low-level technological self-assessment asserted that technology enhances students’ estimation and generalization abilities. In addition to these, preventing misconception was considered as another contribute to student learning at the end of the field experience. PSTs specified that technology can provide opportunities for students to develop their estimating and generalizing ability; to prevent misconceptions; to learn in a meaningful and relational way; to overcome the difficulties about some topics in which they have problems of envisioning.

“There are some properties which I can show easily with DGS. For all parallelograms, the opposite
angles are equal. I can show this on GeoGebra for as much shapes as possible. The angle that occurs where diagonals bisect each other may be $90^\circ$ or not, you can demonstrate that intersection angle of diagonals is not always $90^\circ$. We may prevent misconceptions in this way and help students to generalize.” (PST-1)

PSTs’ Belief Change in Knowledge of Students’ Understandings, Thinking, and Learning in Mathematics with Technology

The second component about students refers to how students can think about, understand and learn mathematics with technology (Niess, 2013). Also PSTs’ views in which they substitute for students belong to this component. PSTs’ beliefs were examined into two groups; beliefs about thinking about mathematics with technology and beliefs about learning mathematics with technology. PSTs’ beliefs were given based on their levels of technological self-assessment in Table 4.

Table 4. PSTs beliefs about students’ understandings, thinking, and learning in mathematics with technology

<table>
<thead>
<tr>
<th>Technological self-assessment level</th>
<th>Time</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>At the beginning of study</td>
<td></td>
<td>Developing positive attitudes</td>
<td></td>
<td>Developing positive attitudes</td>
</tr>
<tr>
<td>Thinking about mathematics with technology</td>
<td></td>
<td>Conceptual and meaningful learning</td>
<td></td>
<td>Conceptual and meaningful learning</td>
</tr>
<tr>
<td>Learning mathematics with technology</td>
<td></td>
<td>Promotes learning topics that are considered as difficult</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>After workshops</td>
<td></td>
<td>Developing positive attitudes</td>
<td></td>
<td>Developing positive attitudes</td>
</tr>
<tr>
<td>Thinking about mathematics with technology</td>
<td></td>
<td>-</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Learning mathematics with technology</td>
<td></td>
<td>Problems with time</td>
<td></td>
<td>Conceptual and meaningful learning</td>
</tr>
<tr>
<td>Thinking about mathematics with technology</td>
<td></td>
<td>Developing positive attitudes</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Thinking in detail</td>
<td></td>
<td>Conceptual and meaningful learning</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>After method course</td>
<td></td>
<td>Developing positive attitudes</td>
<td></td>
<td>Conceptual and meaningful learning</td>
</tr>
<tr>
<td>Learning mathematics with technology</td>
<td></td>
<td>Promotes learning</td>
<td></td>
<td>Preventing memorization</td>
</tr>
<tr>
<td>Thinking about mathematics with technology</td>
<td></td>
<td>-</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Beginning of the field experience</td>
<td></td>
<td>Developing positive attitudes</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>
The emerging themes were developing positive attitudes and conceptual and meaningful learning at the beginning of the study. Developing positive attitudes means drawing students’ attention to mathematics, overcoming prejudices about math, or making them love mathematics. But they did not tell anything about how technology helps to gain aforementioned outcomes. It was seemed that PSTs took themselves as a reference and addressed that visualization facilitates learning:

“Visual manipulatives or representations help me learn in a meaningful and constructive way, so I think students can learn mathematics in the same way with technology.” (PST-6)

When the method course ends, there was a development in PSTs’ beliefs. They remarked students’ interest of technology in their daily lives and suggested that they will love mathematics, and then want to do mathematics if the interest of technology integrates with mathematics. But, they mentioned a constraint. If students are supposed to learn mathematics with technology in a meaningful and conceptual way, all of the students should access technology easily and have the opportunity to accomplish tasks with technology. This idea led a concern in PSTs that have a low technological self-assessment. They pointed out the time problem when students were unchecked. It was assumed that PSTs realized that technology can be used effectively only when all in the class have and know the technology used. This might be an implication that PSTs learnt from their microteaching practices.

There are two quotes from PSTs below. One of them is related to how technology enables conceptual learning. The other one is an important point that should be considered in order to support students to learn mathematics with technology:

“Students can see more and different examples in a sort span of time and this promotes and makes easier learning.” (PST-3)

“It is important that everyone in the class must get the access to technology. If students know how to use technology, they can explore mathematical ideas and don’t need to memorize rules.” (PST-1)

Another concern that PSTs reflected was that technology may take students’ thinking’s place. A PST explained the reason of this concern and remarked the guidance of teachers that forbid using calculators. But, observing and implementing lessons with technology in real classrooms seemed to develop PSTs’ beliefs about students’ understanding with technology. When students would be encouraged to engage activities with technology, this allows them to observe all details in mathematical processes visually; to see the actual

<table>
<thead>
<tr>
<th>After field experience</th>
<th>Learning mathematics with technology</th>
<th>Discovering mathematical ideas by coping with technology individually</th>
<th>Possibility of laziness in the case of overusing</th>
<th>Preventing misconception</th>
<th>The importance of grade level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thinking about mathematics with technology</td>
<td>Developing positive attitudes</td>
<td>-</td>
<td>-</td>
<td>Developing positive attitudes</td>
</tr>
<tr>
<td></td>
<td>Learning mathematics with technology</td>
<td>Discovering mathematical ideas by coping with technology individually</td>
<td>Meaningful learning</td>
<td>Understanding the basic properties of a geometric concept</td>
<td>Conceptual and meaningful learning</td>
</tr>
</tbody>
</table>
figures and measurements. Thus misconceptions can be prevented and students may realize what a mathematical concept consists of and what is needed to construct the concept. A quote that underpins briefly these findings is as follows:

“Students can see the equality of angles and sides easily in a regular polygon given in DGS.” (PST-5)

One PST who had a medium level technological and mathematical background (PST-4) compared her two implementations with and without technology. She told that she could only give one or two perspectives of a parallelogram on the blackboard. She stated “Maybe they (students) thought that properties were valid for only those perspectives I drew on blackboard.” She emphasized that students might conceptualize a prototype parallelogram that is a parallelogram with a pair of horizontal and vertical sides leaning to the right. However, she argued that GeoGebra gave her the opportunity to show that a rectangular is also a parallelogram. In her opinion, she told students that opposite sides and opposite angles is equal in parallelogram and they accepted. They didn’t have a chance to see the equality in sides and angles actually.

Another PST reflected that if a triangle is ‘upside down’ in which the horizontal base of the triangle is on top and the opposing vertex below, she was confused about properties of triangle. She mentioned that students can see the basic properties of a geometric concept regardless of how it looks with DGS.

PSTs’ Belief Change in Curriculum and Curricular Materials That Integrate Technology in Learning and Teaching Mathematics

Teachers consider how to teach topics in curriculum with technology and evaluate technological tools that can be used in mathematics education. Grossman (1990) reported that PSTs’ pupilage observations underlie their decisions about curricular materials in their teaching professions. They don’t regard about their teachers’ choices and tend to make the same. PSTs’ beliefs about this component were examined into two subcategories; curriculum and GeoGebra. Participants stated that they don’t need to learn new software because they have already known GeoGebra that is easy to use for them. They weren’t introduced any software. GeoGebra constituted the most of experiences that PSTs have about teaching and learning mathematics with technology. They mostly mentioned GeoGebra during interviews. Thus, GeoGebra was determined as a subcategory. PSTs’ beliefs about curriculum and curricular materials that integrate technology in learning and teaching mathematics were given in Table 5.
Table 5. PSTs’ beliefs about curriculum and curricular materials that integrate technology in learning and teaching mathematics

<table>
<thead>
<tr>
<th>Time</th>
<th>Technological self-assessment level</th>
<th>Curriculum</th>
<th>GeoGebra</th>
<th>Curriculum</th>
<th>GeoGebra</th>
</tr>
</thead>
<tbody>
<tr>
<td>At the beginning of study</td>
<td>High</td>
<td>Geometry</td>
<td>Dragging</td>
<td>Geometry</td>
<td>Provides accurate drawings in a short time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Searching about topics in the internet</td>
<td>Appropriate for solids</td>
<td>Topics that are available for visualization</td>
<td>Provides lots of examples in which particular properties are valid</td>
</tr>
<tr>
<td>After workshops</td>
<td>Medium</td>
<td>Geometry</td>
<td>-</td>
<td>Manipulatives</td>
<td>Geometry CAS enables making calculations in an easy and short way</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>Searching about topics in the internet</td>
<td>Tending towards manipulatives</td>
<td>Using technology enhances teaching curriculum</td>
<td></td>
</tr>
<tr>
<td>After method course</td>
<td>Low</td>
<td>Different topics from geometry can be taught with technology (e.g. algebra)</td>
<td>Tending towards manipulatives</td>
<td>Different topics from geometry can be taught with technology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Geometry</td>
<td>Solid</td>
<td>Provides instant feedback</td>
<td>Geometry</td>
<td>Can’t teach all of the curriculum with technology</td>
</tr>
<tr>
<td></td>
<td>Topics in which PSTs have difficulty</td>
<td>GeoGebra</td>
<td>-</td>
<td>Tending towards manipulatives</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Construction</td>
<td>Provides accurate drawings in a short time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beginning of the field experience</td>
<td>Low</td>
<td>Tending towards manipulatives</td>
<td>-</td>
<td>Geometry</td>
<td></td>
</tr>
<tr>
<td>After field experience</td>
<td>Geometry</td>
<td>Topics that are difficult to visualize</td>
<td>Topics in which PSTs have experiences about teaching with technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Can’t teach all of the curriculum with technology</td>
<td>Dragging</td>
<td>Provides accurate drawings in a short time</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GeoGebra</td>
<td>Appropriate for solids</td>
<td>Dragging</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Provides accurate drawings in a short time</td>
<td>Provides accurate drawings in a short time</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
At the beginning of the study, all of the PSTs thought that technology can be used in geometry or topics that are appropriate to visualize. They explained the reason of their preference as having more experiences with technology in geometry. They commonly reported that GeoGebra enables them to show that the basic properties of a geometric shape don’t change even though the appearance changes. One PST stated as follows:

“I can use technology mostly in geometry topic, this is because I know GeoGebra and feel confident about using it.” (PST-3)

PSTs’ beliefs seemed to be affected by workshops. They were demonstrated the use of technology in different topics such as algebra. All of them expressed that they realized teaching different topics from geometry with technology. But, they still insisted on considering visualization as a criterion to decide where they use technology. However, a comparison was seen between technology and manipulatives. PSTs specified that manipulatives outweigh technology and didn’t give any explanation about why. PSTs also referred that they can make actual drawings shortly and show a lot of examples for which a set of properties work with GeoGebra. The following original quotes underpin these findings:

“Even though the side lengths and angles vary, it is always a parallelogram. And you can show this in a short time.” (PST-5)

“At that time (beginning of the study) I thought I can teach a little with technology. But now, I realize there are more than I thought I can.” (PST-1)

Manipulatives versus computer applications or software is the most common seen belief after field experience. Some of PSTs reported that they will use manipulatives because they feel more confident with them than technology. They also stated that students didn’t pay attention to GeoGebra as much as they expect in their technology-based implementations. This may be because only PSTs had the opportunity to use GeoGebra on the interactive whiteboard.

“It may be easier to use manipulatives for me because of familiarity with them. They are in evidence, students can touch and see. Even though today’s students are too interested with technology, I didn’t observe any excitement when I introduced GeoGebra to students. I think this happened because they didn’t know anything about GeoGebra. But, I remembered my pupilage, when our teacher used manipulatives we really got excited and payed attention.” (PST-2)

Another insistent opinion about teaching geometry with technology appeared again at the end of the study. However, PSTs’ observations emerged as an important factor affecting their beliefs especially about GeoGebra. When the last interview was conducted, PSTs had implemented two mathematics lessons with technology. Even though these implementations improved their views about GeoGebra, they insisted on using GeoGebra in geometrical concepts.

“I think GeoGebra can be used only for geometry topics. It may be mathematics software but we use it for geometric concepts. Look at the tools above in GeoGebra. They are related to angles, polygons etc. So I think it is fundamentally related to geometry and appropriate for geometry.” (PST-3)

They also addressed the opportunity to show students how to construct mathematical concepts in detail. One PST clarified this statement as the following:

“For example, let us construct a square in GeoGebra. We can ask students what we need to draw a square. They might answer as four sides. We can test whether only four sides are enough for a square with GeoGebra. I think students can see what is needed for mathematical concepts in detail.” (PST-4)
PSTs’ Belief Change in Instructional Strategies and Representations for Teaching and Learning Mathematics with Technologies

PSTs’ had minimum beliefs about instructional strategies related to teaching and learning mathematics with technology. Because their experiences that integrate technology into teaching mathematics were limited. A contradiction was observed between PSTs’ beliefs about how technology should be used and beliefs about drawbacks of technology such as class control and time problem.

At the beginning of the study, PSTs thought that technology can be used to support known concepts (Table 6). They emphasized that students should master mathematical concepts by hand before using technology. This may imply that PSTs don’t feel comfortable with technology and don’t trust on technologies too much. PSTs in the high level of technological self-assessment added using technology to develop new concepts within the context of student-centered instruction. One PST’s statement that addressed supporting concepts is as follows:

“I think we should use traditional methods firstly in order to encourage students to think and learn about mathematics better. After teacher’s lecturing, technology can be used.” (PST-6)

It can be seen that PSTs’ beliefs shifted towards constructivist teaching with workshops and microteaching. They told about learner-centered instruction that aims to develop new concepts. They suggested that teachers should help their students to reason and deduce with technology. Workshops that are designed as technology-based and student-centered mathematics lessons were considered as effective in changing PSTs’ beliefs. The following PST’s quote mentions the relationship between the instructional strategies and teachers’ intention to use technology;

“A teacher may use technology only by oneself and be the only one who controls the technology during teaching and learning mathematics. But, they should guide students to make calculations or assumptions, find patterns, and explore mathematical ideas. Teachers’ choices about instructional strategies affect technology use and role of the teachers and students.”(PST-4)
Table 6. PSTs’ beliefs about instructional strategies and representations for teaching and learning mathematics with technologies

<table>
<thead>
<tr>
<th>Time</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>At the beginning of study</td>
<td>Supporting known concepts</td>
<td>Developing new concepts</td>
<td>Supporting known concepts</td>
</tr>
<tr>
<td></td>
<td>Developing new concepts Problems with time</td>
<td>Supporting known concepts</td>
<td>Supporting known concepts</td>
</tr>
<tr>
<td></td>
<td>Learner-centered instruction</td>
<td>Supporting known concepts</td>
<td>Supporting known concepts</td>
</tr>
<tr>
<td>After workshops</td>
<td>Developing new concepts Learner-centered instruction</td>
<td>Supporting known concepts</td>
<td>Supporting known concepts</td>
</tr>
<tr>
<td></td>
<td>Supporting known concepts Learner-centered instruction</td>
<td>Supporting known concepts</td>
<td>Supporting known concepts</td>
</tr>
<tr>
<td>After method course</td>
<td>Learner-centered instruction Discovery learning Better than lecturing</td>
<td>Teacher’s role: guide Learner-centered instruction Students should be active with technology Students should reason and deduce with technology</td>
<td>Teacher’s role: guide Class control</td>
</tr>
<tr>
<td>Beginning of the field experience</td>
<td>Problems with time Promotes student-teacher interaction</td>
<td>Teacher’s role: guide Learner-centered instruction Students should be active with technology Students should reason and deduce with technology</td>
<td>Teacher’s role: guide Class control</td>
</tr>
<tr>
<td></td>
<td>Class control</td>
<td>Direct instruction if only teacher is active</td>
<td>Direct instruction if only teacher is active</td>
</tr>
<tr>
<td></td>
<td>Lacking knowledge about GeoGebra</td>
<td>Teacher’s role: guide Students should be active with technology</td>
<td>Teacher’s role: guide Students should be active with technology</td>
</tr>
<tr>
<td></td>
<td>Technical problems</td>
<td>Class control</td>
<td>Class control</td>
</tr>
<tr>
<td></td>
<td>Inquiry-based instruction</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Direct instruction if only teacher is active</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Whenever they met real learning environments in schools, they started to fear about losing control during technology use. They stated two main reasons of this fear: the possibility of technical problems and not having enough knowledge about technology. According to PSTs’ statements, lacking knowledge of GeoGebra made them anxious and they failed to control class. One PST specified that she would not tend to use technology when she started her profession and added that she will hardly decide to integrate technology after feeling as an authoritative teacher. The following quote emphasized why it was difficult for PSTs to control class while engaging with GeoGebra:

“It is too difficult to both teach with technology and to control class. I don’t think I am not proficient enough to deal with GeoGebra. I focused on how to use GeoGebra and so I couldn’t pay attention to mathematics discoveries. Students talked between each other.” (PST-2)

Although they had some wonders, they mentioned inquiry-based technology usage to develop new mathematical concepts. They suggested that teachers should pose questions that require inquiry especially in learning environments in which only teachers have access to technology. PSTs’ views show that using
technology doesn’t always mean enabling students to do mathematics. “Why?” and “How?” questions should be absolutely used to promote student reflection with technology. One PST explained what kind of a strategy should be used to promote students’ learning as follows:

“Think a teacher who is attempting to integrate technology by using it only oneself. Technology will not contribute to teachers unless students are included in thinking with technology or using technology to think. Students must be able to make reasoning and be given feedback with technology.” (PST-1)

CONCLUSION AND DISCUSSION

PSTs’ belief change was examined within the context of TPACK components developed by Niess (2005). PSTs were selected based on their different technological and mathematical background, and were interviewed five times (at the beginning, after workshops, after method course, before and after field experience) to trace how and why their beliefs changed. PSTs had simple beliefs related to TPACK components at the beginning of the study and their beliefs changed along with method course and field experience. It was found that the most important factor which has the most effect on PSTs’ beliefs is their experiences about learning and teaching technology in a similar way with other researches (Agyei & Voogt, 2012; Cavin, 2007; Drier, 2001; Mudzimiri, 2012; Niess, 2013).

Figure 3. Technological Pedagogical Mathematical Knowledge model of participants

A model for technological pedagogical mathematical knowledge of participants was suggested in Figure 3. Model was developed considering PSTs’ continual and common beliefs based on the teacher knowledge model of Grossman (1990). According to technological pedagogical mathematical knowledge model of participants, PSTs consider technology as a visualization, simplifier, and motivation tool. They thought that teaching students mathematics with technology support them to develop positive attitudes towards mathematics and to learn mathematics in a meaningful way. They are familiar with geometrical concepts in teaching with technology so they were of the opinion that only geometry topics can be taught with technology. While their experiences of teaching with GeoGebra increased, they enhanced their knowledge and skills about GeoGebra. Nevertheless, they didn’t feel proficient and stated using virtual
manipulatives instead of technology. Pre-mastery beliefs seen at the beginning of the study moved towards post-mastery beliefs. But, teaching practicums in classrooms caused concerns about classroom management.

PSTs’ views were examined due to their mathematical and technological background. Different patterns were only found in the analysis made due to technological self-assessment levels of PSTs. For example, PSTs that have a high level technological self-assessment stated how visualization supports student learning previously from other participants. However, PSTs that have a low level technological self-assessment firstly mentioned class control. Considering how and why PSTs’ beliefs change and what the emerging ideas that affect their beliefs are, this section was divided into two sub-headings.

The Pattern and the Reason of Belief Change of PSTs

According to PSTs, teaching mathematics with technology meant visualization of mathematical concepts at the beginning of the study. This view was seen in the similar studies (Cavin, 2007; Harrington, 2008; Mudzimiri, 2012; NCTM, 2000; Tall, 1998). After workshops and method course, they indicated that teaching with technology might provide giving more examples, drawing accurate diagrams and making calculations easier, and motivating students to engage in the lesson. Bakker and Frederickson (2005) and Harrington (2008) found similar patterns about teaching with technology. Field experience didn’t lead to a change in their beliefs about the role of the technology, but changed the beliefs about how technology supports students’ learning. They stated that technology would promote students’ estimation and generalization abilities and prevents misconception if they were able to access easily to technological tools. These findings are underpinned by Agyei and Voogt (2012), O’Reilly (2006), and Tall (1998).

PSTs suggested integrating students’ interest of technology with mathematics. This will make students to engage in the lesson and want to learn more mathematics. As they enjoy mathematics more, conceptual and meaningful learning may be reached. In the similar studies, researches (Bakker & Frederickson, 2005; Geiger et al., 2012; Harrington, 2008) mentioned about some affordances of technology in supporting students. PSTs detailed conceptual and meaningful learning after workshops and method course. Discovering mathematical ideas and avoiding memorization were new ideas related to students’ learning with technology. PSTs’ views are consistent with a study whose participant is a teacher (Guerrero, 2010). PSTs in the medium-level of technological self-assessment identified a drawback about time while students were left by themselves with technology. Observing in schools didn’t change PSTs’ beliefs so much. One PST expressed that her co-operating teacher overused technology as a representation tool of textbook and identified her wonder about leading laziness in students. PSTs taught polygons with GeoGebra in their field experiences. At the end of the field experience, the emerging theme was students’ mathematical discoveries with technology.

PSTs’ most common belief about curriculum was that only geometry can be taught with technology. Their learning experiences with technology included mostly GeoGebra activities. They learnt geometrical concepts and provided visual representation of geometrical concepts with GeoGebra. This may be why they thought that geometry is the most appropriate topic for teaching with technology. Workshops led a little change and PSTs realized that different subject matter topics such as algebra can be taught with technology. They didn’t teach algebra with technology, so their resistant beliefs about teaching geometry with technology emerged again at the end of the field experience. PSTs’ beliefs about GeoGebra developed in all technological levels as long as they implemented lessons using GeoGebra. PSTs’ lacking knowledge and skills about teaching different topics from geometry with technology have constraint their beliefs. Similarly, researchers (Chen, 2010; Hew & Brush, 2007; Inan & Lowther, 2010) argued that knowledge and skills are the important factors affecting technology integration.

PSTs had a limited repertoire and naïve beliefs about instructional strategies to teach with technology. All of them emphasized that technology should be used to support concepts after those concepts were mastered by hand. PSTs’ beliefs were consistent with yes-but beliefs of Meagher et al. (2011) and post-mastery beliefs of Hansek-Brill (1997). Constructivist-based workshops created awareness in PSTs so that they could think that students may discover mathematical ideas with technology. PSTs’ beliefs changed from yes-but and post-mastery beliefs to yes-and and exploratory beliefs. When they went to field experience, the
issue of class control seemed to shape PSTs’ beliefs. Zbiek and Hollebrands (2008) labeled these beliefs as management concerns. PSTs’ management concerns affected most of the beliefs even though PSTs made a mention about constructivist teaching with technology. The underlying reasons of having problems with class control were not to have enough knowledge about GeoGebra and technical problems that they may face (Harrington, 2008).

Emerging Ideas Affecting PSTs’ Beliefs

Three descriptors were identified as the factors that played an important role in shaping PSTs’ beliefs. These descriptors are visualization, meaningful learning, and class control. Visualization was the most affective view in most of the components especially at the beginning. PSTs’ thoughts about using technology to visualize and support mathematical concepts are the evidence in the first (conception) and fourth (strategy) components. Whenever they talked about students’ meaningful and conceptual learning, they referred to visualization. The idea that visualization leads to conceptual learning exists in the similar studies (Cavin, 2007; Harrington, 2008; Tall, 1998). According to PSTs, visualizing will help students to learn mathematics meaningfully. So the most appropriate topic in mathematics curriculum for technology use is geometry and likewise geometry software is the most appropriate tools. They explored mathematical concepts which are mostly related to geometry with GeoGebra. It may be implied that experiences with GeoGebra affected their beliefs.

PSTs enrolled in a teaching method course and workshops independently from the method course. Also, they planned and implemented two technology-based mini lessons within the context of microteaching. Among all of these, workshops seemed to be most effective in PSTs’ beliefs. They realized that teachers can teach mathematics in a constructive way with technology. Their beliefs moved from supporting mathematical concepts with visualization (post-mastery and yes-but) to developing mathematical concepts by obtaining a lot of examples and getting students’ attention (exploratory and yes-and). PSTs pointed out students’ interest in technology in their daily lives consistent with Prensky (2001)’s notion of digital natives and suggested that incorporating this interest with strategies that aim to promote students’ discoveries with technology will lead to meaningful learning (Geiger et al., 2012; NCTM, 2000), to make students interested in mathematics (Bakker & Frederickson, 2005), and to keep away from memorizing (Guerrero, 2010). Workshops showed their effect on curriculum component, PSTs reflected that technology can be used in different topics. The reason of this change may be models of teaching algebra with technology that were demonstrated in workshops. Hew and Brush (2007) argued that encouraging PSTs to teach with technology would lead to change in their beliefs. This explains the change in PSTS’ beliefs about TPACK with the help of workshops.

PSTs experienced teaching mathematics with technology in real classrooms for the first time in their field experience. It was found that teaching practicums with technology made PSTs anxious about class control. We can make an inference that class control had an important effect on PSTs’ beliefs about TPACK components. They realized the difficulty of teaching with GeoGebra, because PSTs had the only access to technology. They had to both use GeoGebra and help students in mathematical explorations. Students were rarely given the opportunity to use GeoGebra. So, they weren’t interested as well as that PSTs expect. With these factors, PSTs seemed to tend using manipulatives instead of GeoGebra. They insisted on issue of class control many times.

IMPLICATIONS AND LIMITATIONS

It was seen that PSTs’ experiences shaped their beliefs. Their tendency about using manipulatives and GeoGebra is an explicit result of this implication. Also, the lacking of learning mathematics with technology in the pupilage and teaching with technology in classrooms made PSTs’ beliefs robust. But, their beliefs changed a little with workshops and technology-based lesson implementations. There is a limited number of software serves in Turkish and this limited Turkish PSTs to feel comfortable about teaching with technology. TPPs which educate PSTs in Turkish should make a point of preparing PSTs to be able to use different software regardless language. Introducing different software and applications before teaching practicums may be a way of expanding PSTS’ levels of confidence and experience with technology. The content of method courses
should be revised and arranged in order to demonstrate PSTs how technology, pedagogy and mathematics relate to each other.

It was found that PSTs’ limited repertoire of instructional strategies made them feel anxious and fear about losing control in their classrooms. Teacher preparation programs should provide opportunities for PSTs to take mathematics courses with technology; to teach more mathematics with technology and to work with teachers who use technology in an effective way in their field experiences. None of the participants didn’t work with a co-operating teacher using technology. This may be the reason of why belief change wasn’t seen when PSTs first began to field experience. They didn’t see a model of teaching with technology. Thus, PSTs may be paired with a co-operating teacher who uses technology actively and effectively and their beliefs may be examined to determine what kind of patterns of belief change occur in further researches. Also, researchers may work with experienced teachers to see to what extent experience affect teachers’ beliefs about teaching with technology.

PSTs were asked to teach polygons with technology in this study. Their belief changes about teaching different topics with technology didn’t find the opportunity to go into action in PSTs’ behaviors. In another study, PSTs may be asked to teach a topic different from geometry and their belief change may be examined. This study is limited with six pre-service teachers. It may be worth exploring how PSTs’ beliefs will change if the number of participants increases, and participants are selected based on different criterions such as teaching self-efficacy and self-efficacy of technology integration. Further, a longitudinal study in which it is continued to trace participants after their teacher preparation programs during teaching professions may help to understand beliefs and changes of TPACK in a deeper way.

In brief, PSTs may have strong beliefs about teaching mathematics in traditional ways. This is because they have lack of knowledge and experience in learning and teaching mathematics with technology. This study is an evidence of belief change through workshops and technology-based lesson implementations. But it is still unknown whether their beliefs align with their classroom practice and whether change in beliefs also lead a change in their practices.

Acknowledgement

This study comprises one part of the first researcher’s PhD dissertation.

REFERENCES


**APPENDIX**

**An overarching conception about the purposes for incorporating technology in teaching mathematics**

1. What do you think mathematics is?
2. What is the most important point in polygons that students should learn with technology?
3. What is the role of technology in mathematics education?
4. How does technology affect mathematics and vice versa?
5. What are the difficulties in teaching mathematics with technology?
6. How was teaching polygons with GeoGebra?
7. What was the most important point in your implementation and how did technology support your students to learn this important point?

**Knowledge of students’ understandings, thinking, and learning in mathematics with technology**

1. How do students learn mathematics?
2. What do you think about students’ attitudes and prejudices related to mathematics?
3. How does technology affect students’ learning and thinking styles of mathematics?
4. How did GeoGebra support students’ learning and thinking styles of polygons?
5. What are your expectations from your future students?

**Knowledge of curriculum and curricular materials that integrate technology in learning and teaching mathematics**

1. What do you know about national mathematics curriculum?
2. How will you decide whether teaching a topic with technology?
3. What do you think about technological tools that can be used in mathematics education?
4. What do you think about virtual manipulatives that can be used in mathematics education?
5. How does technology affect teaching curriculum?
Knowledge of instructional strategies and representations for teaching and learning mathematics with technology

1. How should mathematics be taught?
2. How do teachers teach mathematics?
3. What do you think the most common used mathematics teaching strategy is?
4. How does technology affect teaching mathematics and instructional strategies employed in mathematics education?
5. How does technology affect classroom management?
6. What do you think students can discover mathematical ideas with technology? How?
Faculty Technology Mentoring Program Facilitates- A Case Study

Ahmet Sami Konca [1], Adem Taşdemir [2]
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[1] Ahi Evran University
samikonca@gmail.com
[2] Ahi Evran University
atasdemmir@gmail.com

ABSTRACT

This study describes a faculty technology mentoring project intended at providing support and mentoring a faculty member. The project took place in Ahi Evran University from February to June 2015. The mentor and mentee weekly met and explored new technologies which were suitable to the mentee’s courses and discussed potential benefits and barriers regarding the implementation of the technology. Process of the project included a collaborative learning community and two-way streaming of information. The mentoring project provided the mentee becoming aware of possible tools, software and applications for using in his teaching processes. The mentee utilized from the project by creating a collaborative learning, observing the mentee’s implementation of the project concerning adjusting and fitting technology, pedagogy, and content. This article discusses the perspectives of both mentor and mentees.

Keywords: educational technology, mentoring, teacher education, technology integration

INTRODUCTION

Humans develop technology when they want to accomplish something and decrease the time consumption and effort required for work (Pepperell & Punt, 2000). Imaginations and wishes have caused change and innovation in technology since Heraclitus (BC 535-BC 475) emphasized the permanence of change. In recent decades, our demands, which yield innovations in technology, to utilize technology in every step and part of life have increased. As a result of our demands for technology in education, which is one of the most important parts of human life, education is on the edge of being transformed through learning technologies (Laurillard, 2008).

In the digital age, it has been accepted that integration of technology into K-12 education is a necessity (Hew & Brush, 2007). Teachers are among the most significant factors affecting the success of technology integration in education (O’Bannon & Judge, 2004). However, the National Association of State Boards of Education (2012) reported that training of teachers “…too often has not kept pace with advances in technology or new ways of learning.” Also, it is reported that educators have not been fully prepared to use technology in classroom. For teachers to use technology effectively, providing technology training for teachers is important. However, selecting appropriate training types are even more important. Training which simply emphasizes basic computer skills will fail in practice of using technology in the teaching process (Zhao & Bryant, 2006). As there may be a variety of different tools for a specific thing, technological or not, need and demand for technological tools can arise when someone is aware of them, chooses them to utilize and gives shape to his or her self-efficacy to use them (Zbiek, Heid, Blume & Dick, 2007). Thus, a technology integration training should have three parts: (1) initial training which prepares teachers to efficiently utilize a variety of educational resources, (2) seminars and in-service trainings to develop competencies and offer ways to integrate technology in education, and (3) both continuous pedagogical and technical support for
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teachers (Vu & Fadde, 2014). Demand for qualified integration programs has risen. Many new teachers have entered positions in schools and they to be able to adapt in the first years. In addition, many teachers are faced with new problems in developing technologies by the day. New teachers mostly want assistance with individualized education programs, curriculum and teaching, behavior management, special education forms, and problems with specific students (White and Mason, 2001). In the natural working environments of teachers, service-learning could be used an alternative education approach to teaching and learning in which they use academic knowledge and skills to address genuine learning needs.

What is service-learning?

Service-learning is an experiential education approach in which reciprocal learning occurs, and both the providers and recipients benefit from the activities (Sigmon, 1979). Students learn and develop through active participation in service-learning (Corporation for National and Community Service, 1990). In this study as a service-learning project, the research described the ICT (Information and Communication Technologies) competencies of a mentee in a graduate-level course via case study. The study aimed to explore the mentoring experience, to develop ICT competences of the mentee in service and offer ways to integrate ICT into education. The study mainly focused on the mentee’s concerns and implementations of technologies in the teaching processes. The teaching processes, in other words, service-learning, is a form experiential education that incorporates mentee reflection and action. Also, service learning includes some benefits for the mentee such as cognitive, interpersonal, and personal development (Zucchero, 2011).

Mentorship can be beneficial for both the mentee and the mentor (Burrell, Wood, Pikes and Holliday, 2001). Mentoring relationships as powerful and unique opportunities are important mechanisms for personal and professional development of individuals at the most basic levels of human caring (Philip-Jones, 1982; Gehrke, 1988; Baugh and Scandura, 1999). Mentorship can be set in five distinct but integral processes (Anderson and Shannon, 1988). These are an intentional process, a nurturing process, an insightful process, a protective and supportive process, and a role modeling process. The role of the mentor in this study was to assist the mentee in using ICT in his classroom. In this respect, the mentoring used in this study was put to work under the protective and supportive process, and the mentor worked as a safeguard and advisor to the mentee during the mentoring project. The mentoring project provided collaboration between the mentor and the mentee and enabled them to explore the process of implementation of technology. Also, the article reports favorable and unfavorable characteristics of the mentoring project and implications.

Theoretical Framework

This study was inspired by the theory of Concern Based Adoption Model (CBAM) which mainly focuses on measuring, describing and explaining adaptation of new materials and technologies (Saunders, 2012). The CBAM also investigates the factors affecting the implementation process. The CBAM model was first published in 1970s and has undergone many validation researches since then. The CBAM is based on five assumptions about the implementation.

- Change is a process, not an event.
- Change is accomplished by individuals.
- Change is a highly personal experience.
- Change involves developmental growth in feelings and skills.
- Change can be facilitated by interventions directed toward the individuals, innovations, and contexts involved.

The CBAM has three key dimensions to clarify the theory’s characteristics. First, stages of concern (SoC) determine a teacher’s feelings and motivations about implementation of materials and technologies. The SoC is about the affective side of change such as a teacher’s reactions, feelings, perceptions, and attitudes. It has seven stages to express a teacher’s cognitive situation, notion and attitude about the
implementation (Table 1). The level of a teacher can be measured by the “Stages of Concern Questionnaire” or simple interview methods.

Table 1: Identifying Stages of Concern (Hall & Hord, p.63)

<table>
<thead>
<tr>
<th>Stages of Concern (SoC)</th>
<th>Expressions of Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 0: Awareness</td>
<td>I am not concerned about it.</td>
</tr>
<tr>
<td>Level 1: Informational</td>
<td>I would like to know more about it.</td>
</tr>
<tr>
<td>Level 2: Personal</td>
<td>How will using it affect me?</td>
</tr>
<tr>
<td>Level 3: Management</td>
<td>I seem to be spending all of my time getting materials ready.</td>
</tr>
<tr>
<td>Level 4: Consequence</td>
<td>How is my use affecting clients?</td>
</tr>
<tr>
<td>Level 5: Collaboration</td>
<td>I am concerned about relating what I am doing with what my co-workers are doing.</td>
</tr>
<tr>
<td>Level 6: Refocusing</td>
<td>I have some ideas about something that would work even better.</td>
</tr>
</tbody>
</table>

The second key dimension, levels of use (LoU), focuses on the pattern of teachers relative to innovation. It claims that users pass levels one by one as they become confident and acquire skills in using innovation. The LoU describes how people are acting with respect to specified change. It has seven stages from non-use to institutionalization (Table 2). Development from one level to another level can be assessed by an interview named the “Levels of Use Interview” and appropriate observations. The last dimension of the CBAM is the innovation configuration (IC). The IC mainly describes the implementation and its operational forms. The IC circumscribes and determines specific features of the implementation. The “Innovation Configuration Component Checklist” can be used to specify key components of the implementation.

Table 2: Behaviors Associated with Levels of Use (Hall & Hord, p.82)

<table>
<thead>
<tr>
<th>Levels of Use (LoU)</th>
<th>Behaviors Associated with LoU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 0: Nonuse</td>
<td>No interest shown in the innovation; no action taken.</td>
</tr>
<tr>
<td>Level I: Orientation</td>
<td>Begins to gather information about the innovation.</td>
</tr>
<tr>
<td>Level II: Preparation</td>
<td>Begins to plan ways to implement the innovation.</td>
</tr>
<tr>
<td>Level III: Mechanical use</td>
<td>Concerned about mechanics of implementation.</td>
</tr>
<tr>
<td>Level IVA: Routine</td>
<td>Comfortable will innovation and implements it as it taught</td>
</tr>
<tr>
<td>Level IVB: Refinement</td>
<td>Begins to explore ways for continuous improvement.</td>
</tr>
<tr>
<td>Level V: Integration</td>
<td>Integrates innovation with other initiatives; does not view it as an add-on; collaborates with others.</td>
</tr>
<tr>
<td>Level VI: Renewal</td>
<td>Explores new and different ways to implement innovation.</td>
</tr>
</tbody>
</table>

Especially the LoU and SoC dimensions were investigated during the first publication date of the model (Newhouse, 2001). However, in this study, the SoC dimension of the CBAM was used to investigate the mentee’s implementation process of the change. The mentor planned the mentoring meetings and needs assessments. To assess the benefits of using ICT in learning environments for the mentee, the authors considered several research questions: Was the mentee more knowledgeable about ICT after the mentoring project in service-learning? What benefits did the mentee report in his reflective interview under the theory of Concern Based Adoption Model (CBAM)? What were the experiences of the mentor? How can we
effectively integrate ICT into education?

METHODOLOGY

Research Design

This mentoring project is a service-learning project in a graduate-level course with a mentor who is an expert on technology applications. The project’s purpose is to increase the mentee’s understanding of ICT under the CBAM. To explore the mentoring project deeply, an instrumental case study in which the researcher focuses on a concern or issue and selects a bounded case to demonstrate the issue was used for this research (Creswell, 2007). An instrumental case study is the study of a case (e.g., person, specific group, occupation, department, organization) to provide insight into a particular issue, redraw generalizations, or build theory (Mills, Durepos and Wiebe, 2010). The meaning of case may vary from one person to a village or from an event to the implementation of a program (Glesne, 2011). The case focused on in the present study was the faculty technology mentoring project which was bounded in one place (a faculty technology mentoring program at Ahi Evran University) and at one period of time (February to June, 2015).

The faculty mentoring program that was first founded in 1991 mainly aimed to support teacher education faculty members with their needs in a variety of information technologies to be used in their teaching processes and professional development. The program has two main parts: a graduate-level course and weekly meetings between the mentor and mentee. The program aims to impact and motivate faculty members to use technology in the educational process (Pamuk & Thompson, 2009). The program initiates collaboration between a mentor and mentee. Graduate students act as mentors and have more experience with technology. Less experienced technology users consist of faculty members and act as mentees. The program creates a learning community in which the mentor provides a variety of technology to the mentee to use the technology in the teaching process. Each week, they meet and design the mentee’s courses in a collaborative atmosphere. The length and content of the meetings is determined by them. They equip the courses with appropriate technologies which may include a wiki, presentation software, a student response system, an online platform, a mobile application, an educational simulation, blog, educational games, etc. They aim to make courses more student-based, engaging and improving the quality of the learning. Gains of the mentor in this program are working collaboratively with someone to accomplish the goal, investigating the process of someone’s implementation of technology and determining the best ways of using technologies. Benefits of the mentee are gaining awareness of a variety of technologies which offers more qualified teaching experiences, the ways of using technologies in their professional development and engaging in a collaborative learning community. The mentor and mentee also discuss the positive and negative sides of technologies to find the best fit of content, pedagogy and technology at the end of the semester (Thompson, 2006).

Figure 1: A General View of the Process

In this study, the faculty mentoring program applied similar procedures as described above. The research process was explained in the process section in detail. Firstly, one of the researchers enrolled in a graduate-level course that includes faculty a technology mentoring program. The course aimed to provide a synopsis of the concepts, theories, models and practice of the implementation of technologies in teacher education. During the semester, the students of the course theoretically analyzed the use of information and communication technologies (ICT) in teacher education. Also, they attended a faculty mentoring program to foster and practice their learning. Then, the mentoring program was continued together through the graduate-level course and weekly meetings between the mentor and mentee.
Participants

Mentor

The mentor, the researcher at the same time, is a research assistant in the elementary education department at Ahi Evran University. He has bachelor’s degree in elementary mathematics education and a master’s degree in early childhood education. He has a personal interest in technology and focuses on technology integration from both the teacher and student perspectives. He has some works on the integration of technology in early childhood mathematics education and the effects of technology on child development. He is also interested in observing an instructor’s teaching process and combining technological and pedagogical knowledge. After observations, he offers some forms of ICT to the instructor to support teaching process. He designs and evaluates the learning process with the instructor together.

Mentee

The mentee is an assistant professor in primary education. His fields of study cover science learning and teaching in teacher training and STEM education in K-8. Furthermore, as a component of the STEM education, he pays attention to technology in the teaching and learning process. Besides, in his courses, he uses microteaching which is a training technique in which a teacher reviews a videotape of the lesson after each session in order to give feedback. He advises using suitable tools in their science instruction to preservice teachers.

The mentee is fairly open to change and he is proficient in using different technologies in daily life. However, he had some concerns about using technologies in his instruction. Of course, he was using a projector for his presentations in the courses. On the other hand, his concerns were keeping him from doing technology-based activities.

The Process

The faculty mentoring program was conducted over the course of four months, from February to June, 2015. During the first month, with the help of the advisory board, the students of the graduate level course developed guidelines needed for an effective ICT mentoring program. Then, they piloted these guidelines in different faculties within a month, and the mentor applied these guidelines for this study. After the first meeting of the mentor with the mentee, they met for two hours once a week, or twice a week if needed. The first meeting was focused on determining the mentee’s demands for implementation of technology in his instructions. Also, the mentor attended one of the mentee’s lessons to observe the mentee’s use of technology and to identify possible solutions and offer advice. The rest of the meetings during the program focused on planning and preparing lessons in which technology assisted the mentee for bettering the students’ learning. They also discussed the mentee’s concerns and roles of technology in teaching. The discussions were important with regard to motivating the mentee and helping him become aware of both why and how to use technology.
In the first meeting, the mentor presented some possible tools and applications to the mentee, i.e. student response systems, YouTube, Google Forms, Moodle, blogs, open resources etc. The mentee investigated them and became familiar with their features and possibilities. He decided to use a Moodle platform, YouTube and Google Forms. He aimed to benefit from Moodle by way of communicating with students, announcing and collecting assignments, sharing electronic sources and YouTube videos which consisted of videos related to microteaching. He used YouTube to share videos in Moodle for the service of the students. He benefited from Google Forms by way of creating a rubric for students’ ranking of the video contents. Besides, the mentor was able to provide a wireless network during and limited in the lessons of the mentee for students’ use. This support was important as the mentee had concerns about students’ access to internet and the concern was limiting his implementations. After five weeks, the mentee created and administered a Kahoot which is a student response system enabling students to answer quizzes by using their mobile phones in a competitive and cooperative atmosphere. The mentor engaged in the implementation process by scaffolding the mentee and discussing the best way of implementation. Also, the mentor attended the first lessons in which the mentee presented the Moodle platform as well as Kahoot.

Data Collection and Analysis

At the beginning and the end of the program as the pre-posttest, The Stages of Concerns Questionnaire (SoCQ) which was created by George, Hall and Stiegelbauer (2006) was used administering to the mentee by the mentor. The SoCQ aims to determine SoC level of an individual. The questionnaire was a seven-point Likert scale and consisted of 35 questions. Each question aimed to reflect a possible concern about technology integration. According to SoCQ manual, individual responses were grouped into seven raw scale scores. Then, raw scores were converted to percentile scores that were provided in the manual. Percentile scores provided an assessment of the practitioner’s feelings and attitudes towards change in an educational context.

The mentor also reflected weekly meetings in a blog which was provided by the mentor’s course. The blog posts included brief summaries of the meetings and comments related to the process. The posts also were discussed in the graduate course. Furthermore, the mentor observed some of the mentee’s lessons and took notes about the implementation, students’ reactions, possibilities and challenges. Lastly, the mentor interviewed the mentee as part of the the faculty mentoring project.

At the end of the semester, the mentor analyzed the questionnaire and interview data. He also explored the data from the blog posts and observation notes. The data obtained from the Stages of Concerns Questionnaire was scored using the Quick Scoring Device included in the manual (George, Hall & Stiegelbauer, 2006). Stake (1995) offers direct interpretation in which the researcher investigates a single instance and figures out meaning from one instance without exploring multiple instances. The mentor pulled the data apart to analyze the data specifically and in depth. Then, he put them back together in more meaningful ways. To support the reliability of the analysis, he triangulated sources of data which consisted of data from the SoC Questionnaire, the interview and the mentor’s blog posts.
FINDINGS

This section consists of findings and themes which emerged from the analysis. The mentor and mentee had a close relationship during the process. Thus, sometimes they changed the roles in a collaborative learning atmosphere. While the mentee was learning tools, software and applications which may be suitable for his courses, the mentor was utilizing this collaboration during the process.

Results from the Mentee Dimension

At the beginning of the program, several questions were asked the mentee to determine his interaction with technology. The mentee had a Smartphone, a tablet, a laptop and a desktop computer. He mainly used the internet for three hours on a typical day. He determined his level of computer use as proficient. However, when it came to technology in an educational context, he was cautious and skeptical.

Graph 1: Results of Pre and Post Stages of Concerns of the Mentee

Graph 1 presents the results of the pre and post scores of the Stages of Concerns Questionnaire above. Among the pre scores, the mentee had his highest percentile on awareness with 99th, second on personal with 89th. He had close percentiles in the middle of 70th on informational, collaboration and refocusing parts of the questionnaire. He had management concerns on percentile with 52nd. He had his minimum percentile on consequence with 21st. When it comes to his post scores, his highest percentiles were on refocusing, informational and awareness with 96th, 95th and 94th, respectively. He had a relatively higher percentile on personal with 83rd among the rest. Besides that, he had close percentiles on management and consequence with 60th and 66th, respectively. His lowest percentile was his collaboration with 52nd percentile. When his pre and post percentiles are compared, it can be seen that he showed increase on informational, management, consequence and refocusing while his percentiles of awareness, personal and collaboration were decreasing.

Stage 0: Awareness

For Stage 0 (Awareness), the mentee’s pre score was at the 99th percentile which indicates little concern regarding technology integration in education. His post score (94th percentile) was also a sign of little concern of the mentee. Only a small improvement in his concern about technology integration occurred during the project. Integration of technology into education was not an area of intense concern. The mentee’s attention was focused elsewhere. At the beginning of the project, in the first meeting, the mentor described his workload as heavy as a cannon ball. He was focusing on preparing his presentations and notes.
for the semester, reporting a study and preparing for publication. Furthermore, he was at the beginning of preparing an application form for a grant. He could find nowhere in his to do list for integration of technology into education.

“The project sounds good but demanding. One wants to allow time for this. However, it is difficult because of courses, working and daily life.”

Stage 1: Informational

Though the mentee could not allow time for implementation of technology at the beginning of the project, he wished to know more about possible technologies in education. The mentee first scored at the 72nd percentile and later 95th percentile in Stage 1 (Informational). Increasing of percentile at the end of the project means that the mentee wanted more information about integration of technology into education. Thus, these levels of percentiles define the mentee as one who is interested in seeking more information about technology integration into education.

At the beginning of the project, the mentee pointed to his utilization of technology during his courses. However, he was limited in presenting the information.

“I use the computer, an interactive whiteboard (if it exists), tablet pc and projection. So, I use them while presenting information. There are some free and paid applications and software which I use on my iPad. In that way, I prepare visually enriched presentations.”

During the project, the mentee wanted to know more about technology, its characteristics, its use and effects. In the first meeting and a part of second meeting, the mentor presented a number of different technologies as tools, software and applications which may have a potential implementation in the mentee’s instructions.

“I am already interested in using technology and this project offered me many options which are new and useful for me.”

This enlightenment was a vital step for the proceeding of the project. By that presentation, the mentor met the need of more information about technologies. The mentee started to analyze them and adapt them in the content of his courses. He later reorganized an outline of his courses and adjusted his instructional methods as per related technology.

Stage 2: Personal

When it comes to Stage 2 (Personal), the mentee first was at the 89th percentile and later the 83th percentile which means the mentee may have some worries about his personal position and well-being in relation to implementation of technology into education. These high percentiles showed that the mentee had doubts about being an effective implementer and questions about institutional support. He also had a lack of certainty related to rewards for integration technology into education. This profile can be identified as “one/two split.” Although he had some priorities and could not find any time to focus on technology integration into education, he was keen on learning new technologies and possible implementations of them.

“Our problem is the setting. One of our main barriers is the lack of providing access to a computer laboratory to students who do not have a computer. In addition, there is no wireless network for general use. Though you want to do something, these barriers prevent it. However, if I was sure about their access, I would make more implementation of technology.”

As seen above, his doubts and notions were limiting his acts. He was not a novice in using technology, so he had self-confidence towards technologies. Under these circumstances the mentee was anxious about support in the way of technology integration into education. Furthermore, there was not any wireless network or computer laboratory serving the students. This was important for the mentee as he wanted to be sure of the students’ access to technology. Because of this barrier, after the third week of the project, the
mentee started to use a student response system which was presented by the mentor to motivate the students during the lessons. He and his students used the network for this aim. An overwhelming percentile of the students were actively engaged in the lessons. Furthermore, they used the network in the process of peer evaluation in the microteaching method. While one of the students was presenting a subject, others were evaluating the presentation immediately by using Google Forms which was created a rubric prepared before.

**Stage 3: Management**

The mentee pre scored at the 52nd percentile and post 60th percentile in Stage 3 (Management). This means the mentee first had a middle level of concern about time and other management problems in the process of integrating technology into education. The mentee had a heavy workload during the project. However, he was hard working and scheduled his work. Besides, he had no prior time management problems. Also, he pointed out the collaborative role of the mentor as seen below.

“When I had information about the project, I realized that the project have a planned process. As weekly meetings can be checkpoints, when we work systematically, time will not be problem.”

“Besides, because of the role and assistance of the mentee, I became more keen and motivated.”

These might be the reasons for the percentile. Furthermore, as the mentee pointed out above, weekly meetings scheduled his work relating to technology integration. The meetings were checkpoints of the week of planning and implementation of prepared lessons in which the mentee used technology.

**Stage 4: Consequence**

The mentor had his highest improvement on Stage 4 (Consequence), from 21st percentile to 66th percentile. The mentee first had very little concern about the outcomes of integration of technology into education and impact of technology on his students. As it has been pointed out above, he had been using technology only for his presentations at the beginning of the project. He tended to have enough information about technology. Maybe he was aware of technology’s power and potential benefits in educational use. However, he was limiting his integration and utilization of technology for his transfusing of information. The reason for this barrier was limited sources.

“For example, when I desire to present video to students, I cannot embed a video link to the presentation because of lack of a wireless network, it limits me. It hinders me and I cannot reach the efficiency which I desire.”

“I use an iPhone and iPad. They are my assistants, my paper and pencil... The Moodle platform was new for me. It makes giving feedback to students easier.”

During the mentoring process, he used some software and applications. When asked about the benefits of these technologies, he emphasized technology’s main function as making his work easy. Also, he pointed out that using videos and student response systems enriched his lessons and motivated his students.

**Stage 5: Collaboration**

The mentee has a sharing personality towards his colleagues. His pre and post percentiles were 72nd and 78th percentiles respectively in Stage 5 (Collaboration). These percentiles mean the mentee has a tendency of collaboratively working with his colleagues or other people in the process of implementation of technologies in education. Also, during the mentoring project, the mentor and mentee had a collaborative relationship. They shared their knowledge and notions about the process in weekly meetings. Sometimes, they changed their roles and the mentee acted as a mentor while the mentor was acting as a mentee. The stream of information flowed both ways. Furthermore, as the mentor had higher scores on Stage 1: Informational, it can be inferred that he is open to change and has a desire to learn from what others know and are doing. After all, he emphasized the role of collaboration as seen below.
“Many people do not get into the act because of different reasons. However, this project provides a collaboration to start. Therefore, you become more engaging and motivated. I’m sure that faculty members who are not using technology would start using it if they were included. Actually, in the case that technology would be supporting them, they would desire to use it and begin.”

**Stage 6: Refocusing**

The mentee always aims to provide maximum support and the best education for his students. For Stage 6 (Refocusing), he scored at 77th and 96th percentile. This means that the mentee has high concerns about implementation of alternative technologies into education. He had thoughts about increasing the benefits and maximizing effectiveness by implementation of alternative forms of technology in education. As said above, the mentee had desires to know more about new technologies. He was also aware of possible outcomes of using technology in education. Thus, he was keen on trying new technologies in his lessons. In weekly meetings, the mentor and mentee discussed the process of implementation. As a result of the discussions, the mentee revised some of his methods in which he used technology.

“I use technology while presenting lessons. Therefore, I catch students attention by technology as it is something different. This is just thing.”

**Results from Mentor Dimension**

**Hard but Good**

The mentoring project provided many opportunities to the mentor about using new technologies in educational processes as well as discussing the process in a collaborative atmosphere with the mentee. He acquired a confidence towards mentoring someone and sharing knowledge about technology integration into education. He broadened his opinions which consisted of using technologies in his professional development and integration of technology into early childhood education. Thanks to the project, he observed the process which included the adjustment of pedagogical, content and technological knowledge.

Planning of implementation of a new technology in education, content, pedagogy and context must be considered. This statement was made by the mentor at the last meeting. During the faculty mentoring project, the participants of the graduate course mentioned their processes in class discussions. They and their mentees took technology, pedagogy and content into consideration during their mentoring project.

There was a collaborative learning atmosphere consisting of the mentor and mentee. Scaffolding and learning collaboratively were beneficial to developing a sense of sharing. Collaboration served as a catalyzer and the mentor provoked the mentee to discover new technologies and determine their potential uses. This two-way learning (Thompson, 2006) was unique which make the mentoring program so rewarding for both mentor and mentee.

“My mentee likes sharing what he knows. He showed me some applications related to my field... We will try to move forward step by step and make an outline of our work.”

Furthermore, the mentor had another learning community at the graduate course. He interacted with his classmates and shared ideas and knowledge. They could access each other’s mentoring blogs in which a mentor reflected the themes of the weekly meetings. Thus, they were aware of other’s proceedings and situations relating the mentoring project.

The mentor had to overcome some challenges. Like the mentee, he too had a heavy workload. He had to assist the members of the department, offer the course named mathematics education in early childhood education and attend two more graduate courses. Also, he had to investigate the mentee’s needs and support him immediately. He had to establish a close collaboration with the mentee. Besides, he personally attempted to provide technological tools which were necessary for courses of the mentee. He contacted the IT department of the university and borrowed an access point during the mentoring project.
CONCLUSION

The results showed that the technology mentoring project has contributed mostly to the mentee on the informational, management, consequence and refocusing stages. In the interview, the mentee indicated that he achieved more practical experience in the classroom about ICT use during the mentoring project, he needed more technical support with educational applications, and he needed to develop assertive communication skills for working with students and other colleagues. Recommendations from the mentor about the needs of mentee included help with time management, organization skills, understanding ICT and its implications for teaching and more training in his instruction.

It was the first time the mentor acted as a mentor in the faculty mentoring project. He not only supported the mentee but also learned skills from him including time management, planning a course and determining students’ needs. He had the opportunity to interact with the mentee in a collaborative atmosphere. This collaboration produced combinations of technologies to utilize from their special features.

Although there was a time limitation, the mentoring project had an outstanding impact. The mentor and mentee plan to apply for a grant to diffuse the innovations in an educational context. They will adjust the mentoring project for the teachers who are engaged in the FATIH Project which aims to equip all high school teachers and students with tablets in Turkey. They intend to support the teachers who are nearby the faculty.

To sum up, the mentoring project created a collaborative learning community consisting of the mentors and mentees during the semester. The communication became two-way where each component of the community contributed his own expertise and in turn evolved by observing and learning from the others.

Educational Implication

The most important task of the teacher is enhancing student learning (Halpern and Hakel, 2002). An obvious question is “How do we enhance student learning?” To support student learning, productive teachers who fully exploit students’ potential are necessary (Sinlarat, 2002). In service training provides not only many alternatives which support students learning but also the most useful processes in which students learn in their natural settings. In service, experiential education involves direct experience in a setting related to the material in the classroom (Moore, 2000). This study was a mentoring project in service-learning. This study aimed, in service, to assess the benefits of using information and communication technologies (ICT) in learning environments for the mentee as a reflection. Reflection is a vital contributor to the success of service-learning (Zucchero, 2011). So, this study’s results are important because they contribute to the literature with an answer to the question “How can we improve the ICT competence of teachers in service?” From this perspective, the mentoring project can be useful for educators who aim to implement, use or develop in-class processes towards ICT.

Although teachers possess high ICT awareness levels, they might have low levels in terms of personal, consequential, management and refocusing knowledge. Overcoming this issue and contributing to teachers improving their competencies in information, consequence and refocusing fields is possible through suitable ICT mentoring especially for teachers. Management competencies of the mentee showed less improvement compared to other competencies. Especially through constant in-class practices, the management competencies can be improved. Also, before starting to implement mentoring programs, the effective factors of teachers’ performances can be determined through making use of ICT attitudes or anxiety scales. Thus, different mentoring programs can be designed for mentees, which in turn would help develop more beneficial in-service-trainings.

Limitations

There are no limitations stemming from the mentee in the process as he voluntarily participated in the study. However, offering a mentee role and determining a volunteer mentee can produce unease. This situation can threaten the determination of the mentee and matching with a mentor. In addition, especially
in the ICT integration process, the most important barrier was physical conditions. Lack of access to a computer laboratory and lack of a wireless network for general use were the biggest problems dealt with by the mentor and the mentee. Retrofitting especially may decrease concerns and bias of the mentee. ICT awareness of the mentee was at a high level. It can be said that this feature of the mentee was an important factor in his voluntarily participation in the mentoring project. Comparisons between the results of this study and other studies can be useful for the reliability of the results.

Other limitations of the mentoring project are the relationship between the mentor and the mentee, their interest level, academic competence, and manner of approach to the events. According to Cronan-Hillix et al. (1986), good mentors can be hard to find, and matching interests and personalities is important for a successful mentor-mentee relationship. Also, the nature of a good mentor-mentee relationship depends on matching the personalities, styles, and interests of mentors and mentees to work effectively (Cesa and Fraser, 1989). In this regard, a good relationship between the mentor and the mentee ease the implementation process of the mentoring project.

To have more extensive findings, similar studies can be conducted with different sample groups. Thus, the problems encountered during the faculty mentoring program and its advantages would be seen clearly. Throughout the qualitative data collection process, the researcher participated in the process as a mentor, which enabled him to gather more detailed data for the study. With the aim of minimizing the self-reflective feature of the mentor in this process, the weekly data was observed by the advisory board, and the related feedback were given to the mentor. Future studies can choose to collect data through more than one mentor in order to prevent the self-reflective feature, which is thought to contribute to collecting more reliable data.

REFERENCES


Indicators of Students’ Intention to Use Massive Open Online Courses for Academic Purposes

Mukaramatu Tahiru [1], Rosemaliza Kamaludeen [2]
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ABSTRACT

Massive Open Online Courses (MOOCs) have a considerable potential impact on teaching, learning, and traditional higher educational structures, according to many types of research. Several higher education institutions either through the specific development of MOOCs or the integration of existing MOOCs into their curriculum are swiftly implementing them on their campuses. To examine the MOOCs phenomenon more closely, this study explored the significant difference between MOOCs users and non-users in their intention to use MOOCs for academic purposes. It again explored the influence of awareness knowledge, how-to knowledge, perceived usefulness, actual usage, and attitude on intention to use MOOCs for academic purposes. The sample consisted of 190 postgraduate students. The analysis procedure made use of independent sample t-test and multiple regression analysis. The findings reveal a significant difference between users and non-users of MOOCs in their intentions to use MOOCs for academic purposes. It again indicated that all predictor variables significantly contribute to the prediction of intention to use MOOCs for academic purposes except how-to knowledge and actual usage. It also reveals that students’ intention to use MOOCs for academic purposes is raised by the perceived usefulness which reflects in their attitude. Awareness knowledge, in turn, incline the perceived usefulness of MOOCs to students signifying that a substantial amount of knowledge of MOOCs is a precursor to a higher level of intention to use.

Keywords: Indicators, MOOCs, Awareness Knowledge, How-to Knowledge, Perceived Usefulness, Attitude, Actual Usage, Intention to Use for Academic Purposes.

INTRODUCTION

The accessibility of higher education has been improved due to increased technology and globalisation. The concept of online learning in recent years has greatly expanded to include an increasing number of Massive Open Online Courses (MOOCs) as well as many higher education courses open for internet users to enrol at no cost. In the field of online learning, MOOCs are current trend that are free and open online courses encouraged by several prestigious universities such as Harvard, Massachusetts Institute of Technology (MIT), Stanford and University of California. MOOCs emerged from Open Educational Resources (OER) movements, coined by Dave Cornier and Bryan Alexander in 2008. Majority of MOOCs comprise relatively short video lectures and related contents whereas feedback on assignments and tests are given either through peer-review and group collaboration or by computerized system (Holdaway & Hawtin, 2013). Among the characteristics of MOOCs is Massive, which means MOOCs easily accommodate large numbers of students. Openness, which involves several key concepts: software, registration, curriculum and assessment, communication including interaction, collaboration, sharing and learning environments. Connectivism, which
offer an emerging online learning theory inspired by a connectivist viewpoint (Rodriguez, 2012). Coursera, Udacity, edX and Udemy are the most popular websites that offer several MOOCs. Coursera is one of the fastest growing MOOCs providers registering about 15.3 million participants with over 127 universities and over 1,300 courses.

Similarly, in Malaysia the acceptance and usefulness of Open Educational Resources and Open Course Ware have led to another buzz concept, Massive Open Online Course (MOOCs). Since its inception in 2008, MOOCs becomes an alternative platform for online learning rapidly. This can be seen in many instances where tertiary education providers started to inaugurate their MOOCs initiatives. For example, in 2013, Taylor’s University, Malaysia began to offer courses through MOOCs. Recently, another university, Universiti Putra Malaysia has also launched its MOOCs initiative called PutraMOOC in April 2014 (Juhary, 2014). Subsequently, twenty (20) public universities in Malaysia upload the e-content of their courses to a local MOOCs platform known as ‘OpenLearning.com’. The emergence of MOOCs in Malaysia has encouraged higher education institutions to admit that traditional teaching and learning methods require a revision and rejuvenation to catch up with the fast-paced, connected, technologically-driven atmosphere of the 21st century (Fadzil et al., 2016).

Several studies have been carried out on the set of factors that enhance individuals’ adoption of online learning. Perceived usefulness plays an important role in students’ acceptance of online learning (Amer, Ahmad & Smedley, 2013). The acceptance and perceived usefulness of OER and OCW have led to the perceived usefulness of MOOCs (Juhary, 2014). Again, perceived usefulness had a significant influence on attitude towards using Learning Management System [LMS] (Juhary, 2014). Some studies have related knowledge, perceived usefulness, attitude, intention to actual usage of online technologies (Al-Adwan et al., 2013; Cheong & Park, 2005; Brennan et al., 2010; Peres, Correia & Moital, 2011; Bolks, 2014).

Online education via Open Learning in Malaysia keeps growing and both public and private institutions are encouraged to provide MOOCs aligned with the Malaysian Education Blueprint 2015 to 2025 (Amrang, 2016). International Islamic University Malaysia is one of the public institutions that offer several MOOCs on OpenLearning.com. Yet, majority of the students do not use them (Amrang, 2016; Mat-jizat et al., 2014). Similarly, little literature exists that explore the set of factors affecting the students’ intention to use MOOCs for academic purposes among postgraduate students in Malaysia and IIUM specifically. This study therefore, explores the set of factors (awareness knowledge, how-to knowledge of MOOCs, perceived usefulness, attitude, actual usage) that determines postgraduate students’ intention to use MOOCs for academic purposes.

**RESEARCH OBJECTIVES**

This research sets to explore the significant difference between MOOCs users and non-users in their intention to use MOOCs for academic purposes. It also explores the influence of awareness knowledge, how-to knowledge, perceived usefulness, actual usage and attitude on intention to use MOOCs for academic purposes.

**RESEARCH QUESTIONS**

1. Is there a significant difference between MOOCs users and non-users in their intention to use MOOCs for academic purposes?

2. Do awareness knowledge, how-to knowledge, perceived usefulness, actual usage and attitude influence intention to use MOOCs for academic purposes?
HYPOTHESIS

H0: There is no significant difference between MOOCs users and non-users in their intention to use MOOCs for academic purposes.

HA: There is significant difference between MOOCs users and non-users in their intention to use MOOCs for academic purposes.

METHODOLOGY

Design: The research employed the ex-post facto design. The method employed in the study was the survey method using a 5-Likert scale questionnaire as the primary means of data collection. Since the data was in the form of numbers, the study was thus quantitative in nature. An exploratory, cross-sectional survey was employed to capture the extent of IIUM postgraduate students’ awareness knowledge, how-to knowledge, perceived usefulness, attitude, actual usage and intention to use MOOCs for academic purposes.

Sample: The sample comprised 190 postgraduate students selected from six kulliyyahs using stratified sampling. Since the sample size was expected to be drawn from students in IIUM whereby they may be in the same level, a simple random sampling technique was employed.

Instrument: Thorough review of literatures has been made to determine the most suitable instrument to be used in addressing the research questions of this study. As a result, the questionnaire items were adapted from four structured questionnaires from Davis (1989), Chen et al. (2008), Venkatesh (2000), Hu and Chau (2001), Lin and Overbaugh (2009), Taylor and Todd (1995), and included new items which were self-developed based on the literatures. The instrument in all contains 32 items measuring awareness knowledge, how-to knowledge, perceived usefulness, attitude, actual usage and intention to use MOOCs for academic purposes. The respondents gave their degree of agreement and disagreement on 5-Likert scale with response category (strongly disagree 1, disagree 2, neutral 3, agree 4, and strongly agree 5).

Data Collection Procedure: The data collection procedure was done through self-administered questionnaires during lecture hours after a permission is granted by the lecturer. Students were also invited to respond to the questionnaires after their classes at the various lecture halls in their respective Kulliyyahs, at the hostels, library, and cafeterias.

Data Analysis Procedure: The statistical analysis was conducted with the aim of answering the research questions. The Statistical Package for the Social Sciences (SPSS) version 17 software was fully utilised in analysing the data. The analysis procedure made use of descriptive statistics to analyse the demographic characteristics of the respondents. Again, independent sample t-test was run to explore and measure the significant difference between users and non-users of MOOCs in their intentions to use MOOCs for academic purposes for the first research question. Multiple Regression Analysis was used for the second research question to identify the significant predictors of respondents’ intention to use MOOCs for academic purposes.

RESULTS

The analysis and findings set out in the research methodology is presented in this chapter. This study aimed at investigating indicators of students’ intention to use Massive Open Online Courses (MOOCs) for their academic purposes. The findings attempt to answer the research questions of this study. The analysis of the data collected from the respondents of this study was done using correlation and independent sample t-test of Statistical Package for the Social Sciences (SPSS) software, version 17. The first research question was answered using independent sample t-test while the second one was answered using bivariate
correlation.

Demographic Characteristics of The Respondents

The majority of the respondents are females accounting for 58.9% (n = 112), whereas 41.1% of the respondents (n = 78) represents their male counterparts. In terms of age, the majority of the respondents (44.7%, n = 85) are within the age group of 25-29. In terms of nationality, majority of those who responded to the survey are local students constituting 53.7% (n = 102), while the international students comprise 46.3% (n = 88). Masters students are revealed to be the majority of the respondents accounting for 72.1% (n = 137), whereas 27.9% (n = 53) represents PhD students. In terms of year of study, the majority of the respondents are in their 1st year making 42.1% (n = 80), followed by respondents in their 2nd year with 38.4% (n = 73). The least number of respondents are in their 4th year and above making 4.7% and 2.1% (n = 9, n = 4) respectively.

Research Question 1: The Difference Between Users and Non-Users of MOOCs In Their Intention to Use MOOCs for Academic Purposes

The Independent Sample T-Test Analysis was conducted to check whether significance difference exist between users and non-users of MOOCs among the respondents. The result of their differences is presented in Table 1.

Table 1: Contrast Between Users and Non-users of MOOCs in their Intention to it for Academic Purposes

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention to use for academic purposes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOOCs Users</td>
<td>41</td>
<td>4.0691</td>
<td>.9775</td>
<td>-.857</td>
<td>51.523</td>
<td>.042</td>
</tr>
<tr>
<td>Non-MOOCs Users</td>
<td>149</td>
<td>3.9295</td>
<td>.6918</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The result of Table 4.4 on Independent Sample T-Test discloses that there is a significant difference between users and non-users of MOOCs in the scores; MOOCs users (M = 4.0691, SD = .9775) and non-MOOCs users (M = 3.9295, SD = .6918) where the 2-tailed significant p<.05; t (51.523) = -.857, p = .042. Evaluated against a level of significance of α=.05, the p-value (.042) is lesser than the level of significance. Therefore, null hypothesis that there is no significant difference between MOOCs users and non-users in their intention to use MOOCs for academic purposes is rejected. Overall, the result suggests that users and non-users of MOOCs have different propensity to use MOOCs for their academic purposes.

However, considering the results, it is clear that the number of non-users of MOOCs (n = 149) far outweighs that of the users (n = 41). This is beyond the researcher’s control as these numbers were derived from the feedback of the respondents. Nonetheless, the researcher does not believe this to be much of an issue as the study is not an experimental research. Additionally, the mean and standard deviation of users of MOOCs are also bigger than that of the non-users, hence, equal variance is not assumed.

Research Question 2: The Predictors of Respondents’ Intention to Use MOOCs for Academic Purposes

Multiple Regression Analysis has been carried out in order to address the research question on the influence of awareness knowledge, how-to knowledge, perceived usefulness, actual usage, and attitude on
students’ intention to use MOOCs for academic purposes. This method presents only the best summary of the model because it drops out the least predictive variables. The model is accounted by the predictive variables; Attitude, Awareness Knowledge, Perceived Usefulness, Actual Usage, How-to Knowledge ($F=25.062$, $df=5,183$, $p=.000$; $p<.005$). All the three models are significant at $p<.05$. The models’ ANOVA results are presented in Table 2.

Table 2: Model’s ANOVA Results

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regression</td>
<td>1589.049</td>
<td>5</td>
<td>317.810</td>
<td>25.062</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>2320.644</td>
<td>183</td>
<td>12.681</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>3909.693</td>
<td>188</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Regression</td>
<td>1584.791</td>
<td>4</td>
<td>396.198</td>
<td>31.356</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>2324.903</td>
<td>184</td>
<td>12.635</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>3909.693</td>
<td>188</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Regression</td>
<td>1577.104</td>
<td>3</td>
<td>525.701</td>
<td>41.694</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>2332.589</td>
<td>185</td>
<td>12.609</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>3909.693</td>
<td>188</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), Attitude, Awareness Knowledge, Perceived Usefulness, Actual Usage, How-to Knowledge

b. Predictors: (Constant), Attitude, Awareness Knowledge, Perceived Usefulness, Actual Usage

c. Predictors: (Constant), Attitude, Awareness Knowledge, Perceived Usefulness

d. Dependent Variable: Intention

The comparison of the model based on predictive variables are presented in Table 4.6. Model 1 in Table 4.6 offers the best explanation of variance where 40.6% of the model is affected by the predictors ($R^2 = .406$). The variance for model 2 shows that 40.5% of the model is affected by the predictors ($R^2 = .405$). In model 3, 40.3% of the model is affected by the predictors ($R^2 = .403$). Similarly, the model is accounted by the predictive variables; Attitude, Awareness Knowledge, Perceived Usefulness, Actual Usage, How-to Knowledge ($F=25.062$, $df=5,183$, $p=.000$; $p<.005$) as shown in Table 3.

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Table 3: Model Summary of Backward Linear Regression

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Squared</th>
<th>Adjusted R Squared</th>
<th>Std. Error of the Estimate</th>
<th>Change Statistics</th>
<th>Sig. F Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>.637b</td>
<td>.405</td>
<td>.392</td>
<td>3.55462</td>
<td>-.001</td>
<td>.336</td>
</tr>
<tr>
<td>3</td>
<td>.635c</td>
<td>.403</td>
<td>.394</td>
<td>3.55086</td>
<td>-.002</td>
<td>.608</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), Attitude, Awareness Knowledge, Perceived Usefulness, Act. Usage, How-to Knowledge
b. Predictors: (Constant), Attitude, Awareness Knowledge, Perceived Usefulness, Act. Usage
c. Predictors: (Constant), Attitude, Awareness Knowledge, Perceived Usefulness
d. Dependent Variable: Intention

The beta and statistical significance in Table 4 have shown that all predictor variables significantly contribute to the prediction of intention to use MOOCs for academic purposes except how-to knowledge and actual usage. Predictor variables influence intention to use MOOCs for academic purposes by awareness knowledge $\beta=.100$ ($p=.008; p<.005$); perceived usefulness at $\beta=.458$ ($p=.000; p<.005$); and attitude at $\beta=.204$ ($p=.005; p<.005$). It can be concluded that the relative strength of the beta weights indicate that perceived usefulness is the most statically significant predictor of intention to use MOOCs for academic purposes.

Table 4: Model Summary of Coefficients

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>7.857</td>
<td>1.511</td>
<td>5.199</td>
<td>.000</td>
</tr>
<tr>
<td>Awareness knowledge</td>
<td>.176 (.045)</td>
<td>.100 (.458)</td>
<td>1.699</td>
<td>.008</td>
</tr>
<tr>
<td>Perceived Usefulness</td>
<td>.424 (.066)</td>
<td>.458 (.6403)</td>
<td>6.403</td>
<td>.000</td>
</tr>
<tr>
<td>Attitude</td>
<td>.262 (.093)</td>
<td>.204 (.2812)</td>
<td>2.812</td>
<td>.005</td>
</tr>
</tbody>
</table>

Dependent Variable: Intention to use MOOC for academic purposes;

R2 =.406, F=25.062, df=5,183, p=.000; p<.05

General explanation of the model prediction is explained by the intention to use MOOC for academic purposes = .176 awareness knowledge +.424 perceived usefulness +.262 attitude. The relative impact reveals that

i. For every unit of .176 of students’ awareness knowledge increases the intention to use MOOC for academic purposes ($\beta=.176; t=1.699, p=.008$).

ii. For every unit of .424 perceived usefulness increases the intention to use MOOC for academic purposes ($\beta=.424; t=6.403, p=.000$).

iii. For every unit of .262 attitude increases the intention to use MOOC for academic purposes ($\beta=.262; t=2.812, p=.005$).

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DISCUSSION

One of the objectives of this study is to find the difference between users and non-users of MOOCs in their intention to use MOOCs for academic purposes. Using independent sample t-test to determine the difference between users and non-users of MOOCs, the findings revealed that there is a statistical significant difference between the two groups. This may be attributed to the respondents’ prior knowledge of MOOCs and their strong desire to use the technology because of its perceived usefulness to them (Soheila, 2014). The result again suggests that, students who had experienced with MOOCs and consequently were more familiar with the ability of the technology to help them in their academic pursuit had positive perception of it and are willing to use it specifically for their program of study. This idea is similar to those students who have no experience with MOOCs due to the fact that they were briefed on what MOOCs actually is, as such, they anticipated its ability to assist them in pursuit of their program of study.

These findings are consistent with that of (Bagarukayo, 2015) who found a difference in using eLearning among universities in South Africa. In addition, there was statistical significant difference between users and non-users of eLearning materials on medicine (Chui, Abdullah, Wong & Taib, 2015). Again, in similar study, Sheila (2014) found statistically significant difference between users and non-users of GeoGebra in their perceived usefulness, ease of use, current competences, and their intention to use it. The predictors of students’ intention to use MOOCs for academic purposes were extracted from the data using multiple linear regression model with awareness knowledge, how-to knowledge, perceived usefulness, and attitude as independent variables and intention to use MOOCs for academic purposes as dependent variable. The result of the multiple linear regression analysis indicated that all predictor variables significantly contribute to the prediction of intention to use MOOCs for academic purposes except how-to knowledge and actual usage. It shows that when students become aware of MOOCs and perceived it to be useful, they develop a positive attitude towards it thereby develop the intention to use it for academic purposes in the near future.

The result of the Multiple Regression Analysis (MRA) again illustrated that the most significant predictor of perception towards the intention to use MOOCs for academic purposes was its perceived usefulness. This was in line with several empirical studies which found perceived usefulness to be a strong determinant of user intentions (Teo, 2008; Venkatesh & Davis, 2000). These findings again support that of Mamma (2016) who found awareness knowledge and how-to knowledge as significant predictors of students’ intention to use BookMyne. This also agrees with the results of Stols and Kriek (2011) research who reported perceived usefulness as the most significant predictor of attitude towards the use of dynamic geometry software. It is also consistent with the study of Sheila (2014) who discovered that teachers’ perceived usefulness and teachers perceived current competencies statistically significantly predict their intention to use GeoGebra in teaching mathematics in the classroom. Similarly, Multiple Regression Analysis was used in the works of Ploger (2011) to determine the factors concerning superintendent longevity and continuity relative to students’ achievement. Berland and Thornton (2013) also used Multiple Regression Analysis to determine the effect of communication technology distraction on students’ performance.

CONCLUSION AND RECOMMENDATIONS

One of the most important activities students do is to explore learning materials with the available technology, and use the essential information derived from them. This greatly goes to shape their learning experiences. Comparable to many other areas of educational sector, teaching and learning are reshaped by current technological development. MOOCs have attracted so much attention that they are seen as having the potential for helping with important higher education challenges. By making high quality educational content from some of the world’s top universities freely available to anyone with Internet access, MOOCs appear to hold potential for improved access to education. As MOOCs begin to achieve recognition with higher education some universities offer some. This study therefore explored the significant difference between MOOCs users and non-users in their intention to use MOOCs for academic purposes. It also explored the influence of awareness knowledge, how-to knowledge, perceived usefulness, actual usage, and attitude on intention to use MOOCs for academic purposes. Using independent sample and multiple regression
analysis, the results showed that the results again showed a significant difference between users and non-
users of MOOCs in their intentions to use MOOCs for academic purposes. It also indicated that awareness
knowledge, perceived usefulness and attitude are significant predictors of intention to use MOOCs for
academic purposes.

It again reveals that students’ intention to use MOOCs for academic purposes was raised by the
perceived usefulness which reflected in their attitude. Awareness knowledge in turn inclined the perceived
usefulness of MOOCs to students. Additionally, there was a significant pathway between awareness
knowledge and students’ intention to use MOOCs for academic purposes, signifying that a substantial
amount of knowledge of MOOCs is a precursor to higher level of usage of the technology. This indicated that
adoption begins with knowledge which subsequently create perception (usefulness) of the technology or
product thereby contributing to the greater intention to use. Nonetheless, despite the evidence suggesting
the importance of knowledge in the usage of MOOCs, not all the respondents of this study who have the
awareness and how-to knowledge of MOOCs use it. Thus, it is not a guarantee that knowledge of any services
or technology is a precursor to positive attitude towards that technology, it is rather the perceived
usefulness.

It is therefore, important for the university authority to intensify the creation of awareness of the
technology by means of booklets, posters, fliers, through students iTaleem accounts, student portals, MOOCs
clubs, briefing newly admitted students about MOOCs during each Kulliyyah briefing and the likes of these.
Again, university authorities should improve the IT infrastructure of all Kulliyyahs and hostels so students can
find it easy to participate in MOOCs and in any other online activities related to their program of study.
Finally, university management should liaise with the popular MOOCs Providers such as Coursera, Udacity,
edX and Udemy to provide courses on their websites. This will then further project the image of the university
globally.

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Pre-service Teachers’ Perceived Ease of Use, Perceived Usefulness, Attitude and Intentions Towards Virtual Laboratory Package Utilization in Teaching and Learning of Physics

Oluwole Caleb FALODE [1]
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ABSTRACT

This study was carried out to investigate pre-service teachers’ perceived ease of use, perceived usefulness, attitude and intentions towards the utilization of virtual laboratory package in teaching and learning of Nigerian secondary school physics concepts. Descriptive survey research was employed and 66 fourth and fifth year Physics education students were purposively used as research sample. Four research questions guided the study and a 16-item questionnaire was used as instrument for data collection. The questionnaire was validated by educational technology experts, physics expert and guidance and counselling experts. Pilot study was carried out on year three physics education students and a reliability coefficients ranging from 0.76 to 0.89 was obtained for each of the four sections of the questionnaire. Data collected from the administration of the research instruments were analyzed using descriptive statistics of Mean and Standard Deviation. A decision rule was set, in which, a mean score of 2.50 and above was considered Agreed while a mean score below 2.50 was considered Disagreed. Findings revealed that pre-service physics teachers perceived the virtual laboratory package easy to use and useful with mean scores of 3.18 and 3.34 respectively. Also, respondents’ attitude and intentions to use the package in teaching and learning of physics were positive with mean scores of 3.21 and 3.37 respectively. Based on these findings, it was recommended among others that administrators should equip schools with adequate Information and Communication Technology facilities that would aid students and teachers’ utilization of virtual-based learning environments in teaching and learning process.

Keywords: Virtual laboratory package, Ease of use, Perceived usefulness, Attitude, Behavioural intentions, Technology acceptance model

INTRODUCTION

The application of computer technology in classroom environment has a significant role in enhancing teaching and learning. For instance, the use of artificial educational environment such as simulations and virtual reality in teaching and learning is increasingly becoming widespread and has proven to be effective in teaching difficult subjects in science (Babateen, 2011). ICTs have the potential to accelerate, enrich, and deepen skills, to motivate and engage students, to help relate school experience to work practices, create economic viability for tomorrow’s workers, as well as strengthening teaching (Yusuf, 2005).
In science and engineering education, virtual laboratories have emerged as alternative or supplementary tools of the hands-on laboratory education (Mahmoud & Zoltan, 2009). Virtual laboratory is an interactive environment without real laboratory tools meant for creating and conducting simulated experiments (Babateen, 2011; Harry & Edward, 2005). It provides students with tools and materials set on computer in order to perform experiments saved on CDs or on web site (Babateen, 2011; Nunn, 2009).

The roles of virtual laboratory in teaching and learning process cannot be over-emphasized. The rapid increase in the use of educational computer has led to changes in the teaching and learning process, curricula and teachers’ approach to instruction (Loveless & Ellis, 2002). These changes in instructional techniques are shaped by the fact that computer-assisted learning increases student’s motivation and creates better learning environments in which rote- learning is minimized and meaningful learning can occur (Renshaw & Taylor, 2000).

Virtual laboratory makes students become active in their learning, provide opportunities for students to construct and understand difficult concepts more easily and it allows students to repeat demonstrations that they do not understand or as a review for examinations. Empirical studies on the effects of virtual laboratory on students’ academic performance revealed the effectiveness of virtual laboratory in teaching and learning process, especially in science subjects (Efe & Efe, 2011; Kevin & Rod, 2012; Mahmoud & Zoltan, 2009; Tuysuz, 2010; Yuen-Kuang & Yu-wen, 2007).

The technological development of any nation lies in the study of science. Science is the foundation upon which the present day technological breakthrough and innovations are built and every nation of the world is striving to develop and be relevant globally both scientifically and technologically (Falode, 2014). One of the core science subjects is physics and it is a requirement for many specialized science and engineering courses at the universities and other tertiary institutions.

Facilities in many conventional physics laboratories in Nigerian secondary schools are inadequate and where they are adequate, the laboratory is only opened to learners during the school working hours thereby hindering students from engaging in independent and self-paced learning of physics. To tackle the menace therefore, Falode (2014) developed a Virtual Laboratory Package on Nigerian secondary school physics concepts, evaluated its’ effectiveness and found that students’ performance was greatly improved when they learnt the subject through the package.

Effective utilization of the developed Virtual Laboratory Package in Nigerian secondary schools would depend largely on the level of acceptance of the package among physics teachers. Technology Acceptance Model by Davis (1989) is believed to be one of the most influential models widely used in the studies of the determinant of technology acceptance. TAM determines the user acceptance of any technology perceived usefulness, perceived ease of use, attitude and behavioural intentions to use such technology (Abu-Dalbouh, 2013).

Perceived usefulness is regarded as the degree to which an individual believes that using a particular technology will enhance his task performance. Perceived Ease of Use is described as the degree to which an individual believes that using a particular technology is free of physical and mental effort. Attitude towards technology usage determines the kind of intention to usage of a particular technology while an individuals’ intention to use technology determines the actual usage (Abu-Dalbouh, 2013; Davis & Venkatesh, 2004; Davis et al., 1989).

A few studies on users’ perceived ease of use, perceived usefulness, attitude and behavioural intentions towards technology usage were reviewed. For instance, Alharbi and Drew (2014) carried out a study on using the technology acceptance model in understanding academics’ behavioural intention to use learning management systems. Findings revealed that respondents perceived ease of use, perceived usefulness, attitude and behavioural intentions towards usage of electronic learning was positive. Also, Ndubisi et al. (2001) in a study on model testing and examining usage determinants, found that users perceived usefulness of computer technology determines the actual usage of such technology. Bijeikiene, Rasinskiene and Zutkiene (2011) investigated teachers’ attitudes towards the use of blended learning in the
classroom and found that teachers’ attitude towards electronic learning was positive.

Though the developed virtual laboratory package was found effective in teaching and learning of secondary school physics by Falode (2014), it is not clear whether physics teachers would accept and use the package in the actual teaching of the subject. Hence, this study sought pre-service teachers’ perceived ease of use, perceived usefulness, attitude and behavioural intentions towards the usage of the package in teaching and learning of physics.

**Research Questions**

The following research questions guided the study:

1. What is the perception of pre-service physics teachers on the ease of using virtual laboratory package?
2. What is the perception of pre-service teachers on the usefulness of virtual laboratory package in teaching and learning of physics?
3. What is the attitude of pre-service teachers towards virtual laboratory package utilization in teaching and learning of physics?
4. What is the behavioural intention of pre-service teachers on virtual laboratory package utilization in teaching and learning of physics?

**Methodology**

This study adopted descriptive survey research design. The methodology involved the use of questionnaire to elicit needed responses from pre-service teachers on their perceived ease of use, perceived usefulness, attitude and behavioural intentions towards virtual laboratory package utilization in teaching and learning of physics.

The population of the study comprised of all physics education students in Federal University of Technology, Minna, Nigeria. This was because within the study area, only the University offers bachelor’s degree programme in physics education. Purposive sampling technique was used to select all the physics education students in their 4th and 5th year in the University. This was because, students in their fourth year were imminently preparing to go for a mandatory six-month teaching practice exercise in secondary schools across Nigeria while students in the 5th year just returned to the university after completing the same six-month exercise. Hence, students in the two classes were considered to have been prepared for teaching profession. A total of 66 (all the 32 students in 4th year and all the 34 students in the 5th year) was therefore selected as sample for this study.

Two research instruments were used for the study. They are: Questionnaire on Pre-service Teachers’ Perception of Virtual Physics Package Utilization (QPTPVLPUS) and Virtual Laboratory Package (VLP). QPTPVLPUS was adapted from Alharbi and Drew (2014) Questionnaire on Technology Acceptance Model and it consists of five sections (Sections A-E). Section A was used to collect demographic data of the respondents, Section B consists of six items on perception of respondents on ease of using VLP, Section C consists of five items on respondents’ perceived usefulness of VLP, Section D consists of three items on attitude of respondents towards VLP utilization while Section E consists of two items on respondents’ behavioural intentions towards VLP utilization in teaching and learning of physics. A four-point rating scale of Strongly Agree, Agree, Disagree and Strongly Disagree was used in weighing responses to the questionnaire items.

VLP was adopted from Falode (2014). It was developed using Adobe Flash CS6. The programming language used was Actions script 3.0 while the Graphic User Interface (GUI) was created using Adobe Fireworks CS6. Box2D was used for the physics simulation engine and Camstudio software was used in recording the video tutorial. The package is meant for performing secondary school physics experiments.
(simple pendulum experiment, Hooke’s law experiment and momentum experiment). The entrance menu of the package consisted of introduction/student’s registration edifice, list of practical lessons (Lessons 1, 2 & 3) and exit button. The main menu is divided into three sections, namely, lesson note section, where the learner is able to study the content for the experiments; Video section, where the learner is able to watch tutorial of how to use the package; and laboratory section where the learner is able to perform the experiments.

The questionnaire was validated by two physics lecturers, two educational technology experts and two guidance and counselling experts. Their suggestions were used to modify and improve the items. To determine the internal consistency among the items of the questionnaire, a pilot study was carried out using 3rd year physics education students at Federal University of Technology, Minna, Nigeria. The questionnaire was administered once on the pilot study sample and Cronbach Alpha’s formula that was used to determine its’ reliability yielded 0.89, 0.78, 0.81 and 0.76 coefficients for Sections A, B, C and D respectively. Hence, the questionnaire was considered suitable for the main study.

The virtual laboratory package as well as its user’s manual are available to the study population in the university departmental library. Hence, they always have access to it before, during and after the study. However, the same package was projected to the respondents for the purpose of this study before they were requested to complete the questionnaire. The duly completed questionnaires were retrieved same day they were administered.

Data gathered from the administered questionnaires were analyzed using descriptive statistics. Mean and standard deviation were used to answer the four research questions. A four-point rating scale of Strongly Agree (SA, 4 points), Agree (A, 3 points), Disagree (D, 2 points) and Strongly Disagree (SD, 1 point) was used in weighing responses to items in the questionnaire. Responses on each questionnaire item were analyzed according to frequencies and mean rankings. First of all, total responses in each scale category (frequency) of every item were tabulated. Next, the number of points allocated to each category was multiplied by the frequency of each category (n). Lastly, the sum of these scores was divided by the sum of the frequency for each category (ΣN).

\[
\text{Mean} = \frac{[4 \times N(SA)] + [3 \times N(A)] + [2 \times N(D)] + [1 \times N(SD)]}{\Sigma N}
\]

A mean response below 2.50 was considered disagreement while a mean response of 2.50 and above was considered as agreement.
RESULTS

In this section, Table 1-4 are presented with their interpretations tailored towards providing answers to the research questions raised to guide this study.

Table 1: Mean and standard deviation of pre-service physics teachers’ response on perceived ease of using virtual laboratory package

<table>
<thead>
<tr>
<th>S/N</th>
<th>Item</th>
<th>N</th>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
<th>St. Dev</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I feel that using virtual laboratory package would be easy for me.</td>
<td>66</td>
<td>24</td>
<td>42</td>
<td>0</td>
<td>0</td>
<td>3.36</td>
<td>0.86</td>
<td>Agree</td>
</tr>
<tr>
<td>2</td>
<td>I feel that my interaction with virtual laboratory package would be clear.</td>
<td>66</td>
<td>20</td>
<td>46</td>
<td>0</td>
<td>0</td>
<td>3.30</td>
<td>0.80</td>
<td>Agree</td>
</tr>
<tr>
<td>3</td>
<td>I feel that it would be easy to become skillful at using virtual laboratory package.</td>
<td>66</td>
<td>26</td>
<td>36</td>
<td>4</td>
<td>0</td>
<td>3.21</td>
<td>0.71</td>
<td>Agree</td>
</tr>
<tr>
<td>4</td>
<td>I would find virtual laboratory package flexible to interact with.</td>
<td>66</td>
<td>24</td>
<td>36</td>
<td>6</td>
<td>0</td>
<td>3.09</td>
<td>0.59</td>
<td>Agree</td>
</tr>
<tr>
<td>5</td>
<td>Learning to operate virtual laboratory package would be easy for me.</td>
<td>66</td>
<td>26</td>
<td>38</td>
<td>2</td>
<td>0</td>
<td>3.30</td>
<td>0.80</td>
<td>Agree</td>
</tr>
<tr>
<td>6</td>
<td>It would be easy for me to get virtual laboratory package to teach physics.</td>
<td>66</td>
<td>12</td>
<td>34</td>
<td>16</td>
<td>4</td>
<td>2.81</td>
<td>0.31</td>
<td>Agree</td>
</tr>
<tr>
<td></td>
<td>Grand Mean</td>
<td>66</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.18</td>
<td></td>
<td>Agree</td>
</tr>
</tbody>
</table>

Table 1 shows the Mean and Standard Deviation of pre-service teachers’ response on their perceived ease of using Virtual Laboratory Package. The table reveals the computed mean score of 3.36 with Standard Deviation of 0.86 for item one, 3.30 with Standard Deviation of 0.80 for item two, 3.21 with Standard Deviation of 0.71 for item three, 3.09 with Standard Deviation of 0.59 for item four, 3.30 with Standard Deviation of 0.80 for item five and 2.81 with Standard Deviation of 0.31 for item six. The table reveals further that, the grand mean score of responses to the six items was 3.18 which was greater than the decision mean score of 2.50. This implies that pre-service teachers agreed to the items generated and perceived Virtual Laboratory Package easy to use in teaching and learning of physics.
Table 2 shows the Mean and Standard Deviation of pre-service teachers’ response on their perceived usefulness of Virtual Laboratory Package. The table reveals the computed mean score of 3.55 with Standard Deviation of 1.55 for item one, 3.27 with Standard Deviation of 0.77 for item two, 3.24 with Standard Deviation of 0.74 for item three, 3.33 with Standard Deviation of 0.83 for item four, and 3.33 with Standard Deviation of 0.83 for item five. The table reveals further that, the grand mean score of responses to the five items was 3.34 which was greater than the decision mean score of 2.50. This implies that pre-service teachers agreed to the items generated and perceived Virtual Laboratory Package useful in teaching and learning of physics.
Table 3: Mean and standard deviation of pre-service teachers’ response on attitude towards virtual laboratory package

<table>
<thead>
<tr>
<th>S/N</th>
<th>Item</th>
<th>N</th>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
<th>St. Dev</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I believe it is a good idea to use virtual laboratory package in teaching of physics.</td>
<td>66</td>
<td>24</td>
<td>34</td>
<td>8</td>
<td>0</td>
<td>3.00</td>
<td>0.50</td>
<td>Agree</td>
</tr>
<tr>
<td>2</td>
<td>I like the idea of using virtual laboratory package in physics classroom.</td>
<td>66</td>
<td>26</td>
<td>30</td>
<td>8</td>
<td>2</td>
<td>3.21</td>
<td>0.71</td>
<td>Agree</td>
</tr>
<tr>
<td>3</td>
<td>Using virtual laboratory package is a positive idea in teaching and learning of physics.</td>
<td>66</td>
<td>30</td>
<td>34</td>
<td>2</td>
<td>0</td>
<td>3.42</td>
<td>0.92</td>
<td>Agree</td>
</tr>
</tbody>
</table>

Table 3 shows the Mean and Standard Deviation of pre-service teachers’ response on attitude towards Virtual Laboratory Package. The table reveals the computed mean score of 3.0 with Standard Deviation of 0.50 for item one, 3.21 with Standard Deviation of 0.71 for item two, and 3.42 with Standard Deviation of 0.92 for item three. The table reveals further that, the grand mean score of responses to the three items was 3.21 which was greater than the decision mean score of 2.50. This implies that pre-service teachers agreed to the items generated and have positive attitude towards the utilization of Virtual Laboratory Package in teaching and learning of physics.

Table 4: Mean and standard deviation of pre-service teachers’ response on behavioural intentions to use virtual laboratory package

<table>
<thead>
<tr>
<th>S/N</th>
<th>Item</th>
<th>N</th>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
<th>St. Dev</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I plan to use virtual laboratory package when I become a teacher.</td>
<td>66</td>
<td>26</td>
<td>36</td>
<td>4</td>
<td>0</td>
<td>3.33</td>
<td>0.83</td>
<td>Agree</td>
</tr>
<tr>
<td>2</td>
<td>Assuming that I have access to virtual laboratory package, I intend to use it in teaching of physics.</td>
<td>66</td>
<td>28</td>
<td>38</td>
<td>0</td>
<td>0</td>
<td>3.42</td>
<td>0.92</td>
<td>Agree</td>
</tr>
</tbody>
</table>

Table 4 shows the Mean and Standard Deviation of pre-service teachers’ response on behavioural intentions to use Virtual Laboratory Package. The table reveals the computed mean score of 3.33 with Standard Deviation of 0.83 for item one, and 3.42 with Standard Deviation of 0.92 for item two. The table reveals further that, the grand mean score of responses to the two items was 3.37 which was greater than the decision mean score of 2.50. This implies that pre-service teachers agreed to the items generated and have behavioural intentions to use Virtual Laboratory Package in teaching and learning of physics.
DISCUSSION OF FINDINGS

Findings on ease of using virtual laboratory package reveals that respondents perceived the package easy to use. This finding was in line with the recommendation of Davis (1989) who developed the Technology Acceptance Model (TAM), the views of Davis and Venkatesh (2004) and that of Abu-Dalbouh (2013) that using a particular technology must be free of physical and mental effort. This finding is in agreement with the earlier finding of Alharbi and Drew (2014) who found that academics perceived Learning Management System easy to use. The perceived ease of using virtual laboratory package by pre-service physics teachers was because they have been using electronic means to learn some of their university courses. Therefore, it was not difficult for them to operate and navigate through the package.

Findings on the usefulness of virtual laboratory package reveals that pre-service teachers perceived the package to be useful in teaching and learning of secondary school physics concepts. This finding was in line with the recommendation of Davis (1989) and the views of Davis and Venkatesh (2004) and that of Abu-Dalbouh (2013) that users of a particular technology must perceive it to be useful in enhancing their performance before they can actually use it. The finding also agrees with the earlier finding of Alharbi and Drew (2014) who found that academics’ perception of the usefulness of Learning Management System was positive. Furthermore, this present finding confirms the earlier submission of Ndubisi et al. (2001) that users perceived usefulness of computer technology determines the actual usage of such technology by users. Pre-service teachers perceived the virtual laboratory package useful because they know it would enhance their teaching and make them efficient in teaching of physics.

The finding of this study on attitude reveals that pre-service teachers have positive attitude towards the use of virtual laboratory package in teaching and learning of physics. This finding is not at contrast to the views of Davis (1989), Davis and Venkatesh (2004) and Abu-Dalbouh (2013) that attitude towards technology usage determines the kind of intention to usage of such technology. This present finding is in agreement with the earlier finding of Bijeikiene, et al. (2011) that teachers’ attitudes towards the use of electronic learning in the classroom was positive. In addition, it agrees with the finding of Alharbi and Drew (2014) who found that academics’ attitude towards electronic learning was positive. The positive attitude of pre-service teachers towards the use of virtual laboratory package was as a result of their perceived simplicity and enormous benefits of the package to enrich students’ understanding in the classroom.

Another finding that emanated from this study reveals that pre-service teachers are willing and have positive intentions to use virtual laboratory package in teaching and learning of physics. This finding is in line with the views of Davis (1989), Davis and Venkatesh (2004) and Abu-Dalbouh (2013) that an individual’s intention to use a particular technology determines the actual usage of such. This present finding does not contradict the earlier finding of Alharbi and Drew (2014) who found that behavioural intentions of academics towards usage of electronic learning was positive. Pre-service teachers’ willingness and intentions to use the virtual laboratory package in teaching and learning of physics was as a result of their positive attitude towards the package.

CONCLUSION

This study has revealed that pre-service teachers perceived Virtual Laboratory Package easy to use and useful in teaching and learning of Nigerian secondary school physics concepts. It reveals further that the attitude of pre-service teachers to the use of the package was positive just as they have intentions to use the package upon completion of their teaching education in the University. The use of the package would in no doubt improve students’ achievement in physics and make teachers more efficient in teaching of the subject if proper measures are put in place.
RECOMMENDATIONS

Based on findings that emanated from this study, it is recommended that:

1. Developers of virtual-based learning environments such as Virtual Physics Laboratory Package should ensure they develop packages that are easy to use and perceived useful by teachers. This would enable them have positive attitude and intention to utilize such in teaching and learning process.

2. Administrators should equip schools with adequate Information and Communication Technology facilities that would aid students and teachers’ utilization of virtual-based learning environments such as Virtual Physics Laboratory Package in teaching and learning process.

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